SCIENCE

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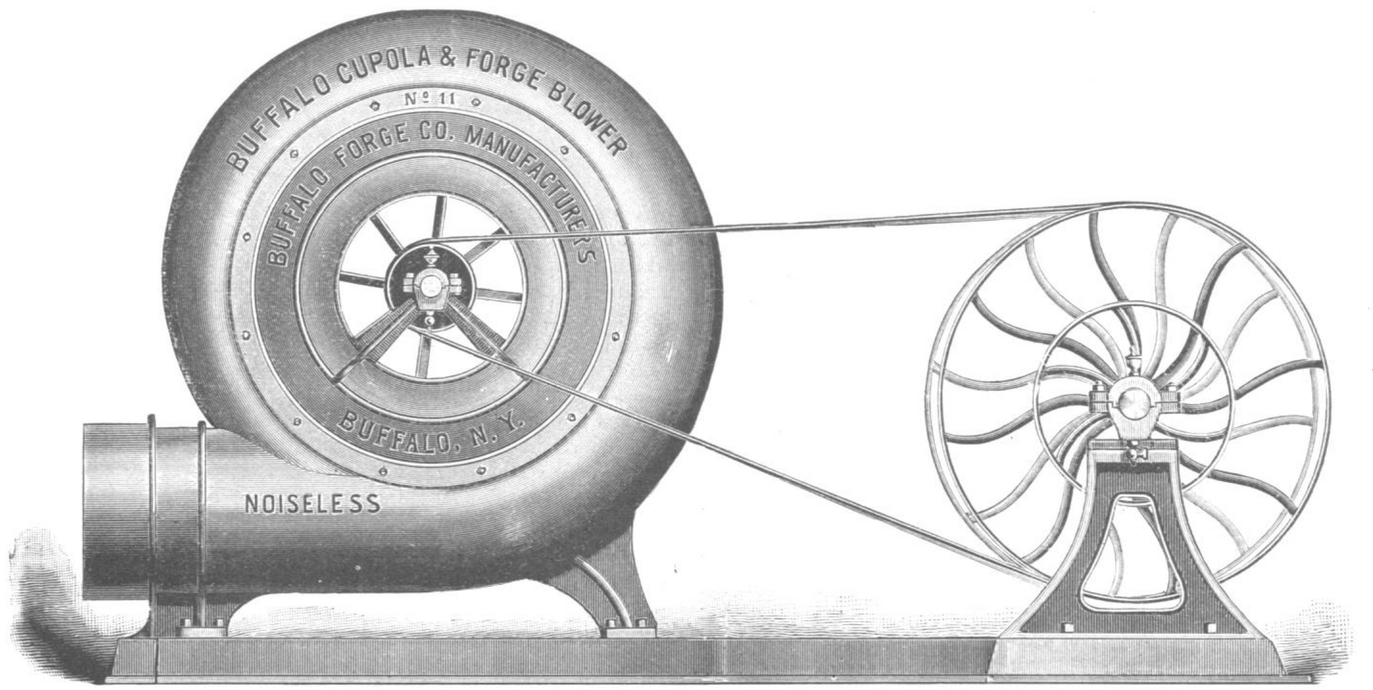
A STEEL PRESSURE-BLOWER.

THE annexed engraving illustrates a steel pressure-blower on a recently perfected pattern of adjustable bed with countershaft, designed and constructed with special reference to high-pressure duty, such as supplying blast for cupola furnaces, forge-fires, and sand-blast machines, also for forcing air long distances. By means of a tightening-screw, the blower may be moved upon the bed while running at full speed, taking up any slack, giving both belts a uniform tension, which is regulated at the will of the operator. This is a very important point in preventing the inconvenience and loss incurred by a stoppage during heat when blowers are used for cupola purposes. By the use of this adjusting device, a great saving is made in the wear and tear of belts, for a simple turn or two of the nut on the adjusting-screw, and a retightening of the holding-down bolts, take but a moment, and accomplish the same end as relacing the belts, which usually is put off until the belt will run no longer on account of slack. Special attention should be directed to pressure-blower belts, on account of the high rate of speed at which they must necessarily run; and absolutely perfect alignment of the countershaft with the blower is essential in order to secure smooth running and even tracking, as well as to avoid undue wear of belts by slipping.



A STEEL PRESSURE-BLOWER.

A telescopic mouth-piece is employed on this blower, in order that the piping may not be disarranged in moving the machine on the bed, and the countershaft is long enough to carry tight and loose pulleys for the main driving-belt. A self-oiling device fitted to the countershaft enables it to be run at high speeds for long stretches with immunity from heat or cutting. A distinguishing feature of these blowers is the solid case, the peripheral portion of the shell being cast in one solid piece, thus dispensing with objectionable joints. The journals are long and heavy, and have cap-bearings secured by bolts held firmly in place by lock-nuts. It is made by the Buffalo Forge Company, Buffalo, N.Y.

THE TOBACCO-PLANT.

AFTER the cereals, there is perhaps no plant so extensively cultivated and utilized as the tobacco-plant. It is grown and employed as a narcotic in almost every country of the world, and it has been calculated that one-fourth of the human family use it.

At the Colonial Exhibition in London, according to the *Journal of the Society of Arts*, the dried leaf and its preparations were shown by India and every one of the British possessions, and the Paris Exhibition has supplemented this display by showing its extensive production in Europe, North and South America, eastern Asia, the Pacific Islands, and the continent of Africa.

It is somewhat difficult to obtain trustworthy information regarding the world's trade in tobacco, because so much is used up locally in different countries. It is probable that the total area under cultivation is not far short of 6,000,000 acres. For the year 1886 certain official returns are available, which show that the United States, India, and Hungary are the largest producers.

The area under tobacco in acres was, in the United States, 752,520; India, 641,000; Hungary and Austria, 149,468; Germany,

49,312; France, 37,156; Algeria, 20,478; Italy, 12,061; Holland, 3,218, — a total of 2,106,213 acres.

The consumption of tobacco in the United Kingdom is large and progressive, and the revenue derived from it last year was nearly $43,750,000. The average consumption is largest in Holland, — nearly 7 pounds per head; in the United States, about $4\frac{1}{2}$ pounds; in Hungary, Denmark, Belgium, and Germany, from 3 to $3\frac{3}{4}$ pounds. In the Australian colonies it is also high, — $3\frac{1}{2}$ pounds; in France it is about 2 pounds; and in the United Kingdom, under $1\frac{1}{2}$ pounds.

The yearly production of tobacco in Cuba is about 300,000 bales, and 181,000,000 cigars are also exported. The Spaniards have hitherto monopolized the trade in cigars, alleging that parts of the soil of Cuba were alone suited to the production of Havana tobacco. This assertion is now disproved, for with good choice of seed, soil, and leaf, and skilled manufacture, Jamaica is said now to send into the market as excellent a cigar as was ever shipped from Havana, and at a far cheaper rate. In the Philippines 100,000 hundredweights of tobacco are produced. The Dutch possessions in the Eastern Archipelago ship a large quantity of excellent tobacco, which is held in high repute in Europe. The imports of Sumatra tobacco in Holland now average 140,000 bales; and of Java tobacco, 130,000 bales.

Although there are about fifty species of the genus *Nicotiana* known, only three or four are much cultivated for the leaf. The two principal commercial forms are by some botanists treated as varieties, and not as distinct species. These are *N. tabacum*, the most extensively cultivated kind of plant, which may be at once recognized by its longish pink flowers and tapering oval-lanceolate sessile leaves; and *N. rustica*, which has short greenish flowers, and stalked ovate, cordate leaves. The leaves are coarser and more crumpled than those of the preceding. This is popularly known as the Turkish form, but is most probably a native of Mexico and California. *N. repanda* is not very extensively cultivated, but is said to yield some of the finest qualities of Cuban tobacco. *N. Persica* furnishes the Persian or Shiraz tobacco. *N. angustifolia*, a species found in Chili, yields a very strong tobacco.

The West Indian, Latakia, and American tobaccos are obtained from cultivated plants of *N. tabacum;* while the Manila, Turkish, and Hungarian are reported to be derived from *N. nistica.* In India *N. rustica* is only cultivated to a very limited extent, and chiefly in eastern Bengal and Cachar, and the leaf is never exported to Europe. *N. tabacum* has become an abundant weed in many parts of India. The gross annual value of the tobacco harvest in Bengal may be roughly estimated at $10,000,000, but the quantity exported is small, averaging only $65,000 in value.

Of the species, *N. macrophylla* is considered to possess the qualities that distinguish a good tobacco in the highest degree. Some of the Havana tobaccos belong to this species. Madras, where the climate is admirably suited for the growth of tobacco, stands first with regard to the development of this industry in India. Dinnigul is the great tobacco district, and cheroots are manufactured at Trichinopoli. The islands in the delta of the Godavery also yield what is called Lunk tobacco, the climate being suitable; and the plants are raised in rather poor light soil, highly manured and well watered. No better evidence could be afforded of the universal use of this plant than the extensive display which was made of it in every section of the Paris Exhibition; and although most of the cases were under seal of the customs, yet many of the kiosks were privileged to sell, such as the Dutch, Belgian, Spanish, Mexican, etc., although the sale and manufacture is a government monopoly in France, and licenses are only granted to privileged people.

WHAT STANLEY HAS DONE FOR THE MAP OF AFRICA.[1]

IT is nineteen years this month since Stanley first crossed the threshold of Central Africa. He entered it as a newspaper correspondent to find and succor Livingstone, and came out burning with the fever of African exploration. While with Livingstone at Ujiji he tried his 'prentice hand at a little exploring work, and between them they did something to settle the geography of the north end of Lake Tanganyika. Some three years and a half later he was once more on his way to Zanzibar, this time with the deliberate intention of doing something to fill up the great blank that still occupied the centre of the continent. A glance at the first of the maps which accompany this paper will afford some idea of what Central Africa was like when Stanley entered it a second time. The ultimate sources of the Nile had yet to be settled. The contour and extent of Victoria Nyanza were of the most uncertain character. Indeed, so little was known of it beyond what Speke told us, that there was some danger of its being swept off the map altogether, not a few geographers believing it to be not one lake, but several. There was much to do in the region lying to the west of the lake, even though it had been traversed by Speke and Grant. Between a line drawn from the north end of Lake Tanganyika to some distance beyond the Albert Nyanza on one side, and the west coast region on the other, the map was almost white, with here and there the conjectural course of a river or two. Livingstone's latest work, it should be remembered, was then almost unknown, and Cameron had not yet returned. Beyond the Yellala Rapids there was no Kongo, and Livingstone believed that the Lualaba swept northwards to the Nile. He had often gazed longingly at the broad river during his weary sojourn at Nyangwé, and yearned to follow it, but felt himself too old and exhausted for the task. Stanley was fired with the same ambition as his dead master, and was young and vigorous enough to indulge it.

What, then, did Stanley do to map out the features of this great blank during the two years and nine months which he spent in crossing from Bagamoyo to Boma, at the mouth of the Kongo? He determined, with an accuracy which has since necessitated but slight modification, the outline of the Victoria Nyanza; he found it to be one of the great lakes of the world, 21,500 square miles in extent, with an altitude of over 4,000 feet, and border soundings of from 330 to 580 feet. Into the south shore of the lake a river flowed, which he traced for some 300 miles, and which he set down as the most southerly feeder of the Nile. With his stay at the court of the clever and cunning Mtesa of Uganda we need not concern ourselves; it has had momentous results. Westwards he came upon what he conceived to be a part of the Albert Nyanza, which he named Beatrice Gulf, but of which more anon. Coming southwards to Ujiji, Stanley filled in many features in the region he traversed, and saw at a distance a great mountain, which he named Gordon Bennett, of which also more anon. A little lake to the south he named Alexandra Nyanza; thence he conjectured issued the south-west source of the Nile, but on this point, within the last few months, he has seen cause to change his mind. Lake Tanganyika he circumnavigated, and gave greater accuracy to its outline; while through the Lukuga he found it sent its waters by the Lualaba to the Atlantic. Crossing to Nyangwé, where with longing eyes Livingstone beheld the mile-wide Lualaba flowing "north, north, north," Stanley saw his opportunity, and embraced it. Tippo-Tip failed him then, as he did later; but the mystery of that great river he had made up his mind to solve, and solve it he did. The epic of that first recorded journey of a white man down this majestic river, which for ages had been sweeping its unknown way through the centre of Africa, he and his dusky companions running the gauntlet through a thousand miles of hostile savages, is one of the most memorable things in the literature of travel. Leaving Nyangwé on Nov. 5, 1876, in nine months he traced the many-islanded Kongo to the Atlantic, and placed on the map of Africa one of its most striking features. For the Kongo ranks among the greatest rivers of the world. From the remote Chambeze that enters Lake Bangweolo to the sea, it is 3,000 miles. It has many tributaries, themselves affording hundreds of miles of navigable drains; waters a basin of a million square miles, and pours into the Atlantic a volume estimated at 1,800,000 cubic feet per second. Thus, then, were the first broad lines drawn towards filling up the great blank. But, as we know, Stanley two years later was once more on his way to the Kongo, and shortly after, within the compass of its great basin, he helped to found the Kongo Free State. During the years he was officially connected with the river, either directly or through those who served under him, he went on filling up the blank by the exploration of other rivers,

[1] J. Scott Keltie, in Contemporary Review, January, 1890.

north and south, which poured their voluminous tribute into the main stream; and the impulse he gave has continued. The blank has become a network of dark lines, the interspaces covered with the names of tribes and rivers and lakes.

Such then, briefly, is what Stanley did for the map of Africa during his great and ever-memorable journey across the continent. Once more Mr. Stanley has crossed the continent, in the opposite direction, and taken just about the same time in which to do so. Discovery was not his main object this time, and therefore the results in this direction have not been so plentiful. Indeed, they could not be; he had left so comparatively little to be done. But the additions that he has made to our knowledge of the great blank are considerable, and of high importance in their bearing on the hydrography, the physical geography, the climate, and the people of Central Africa.

Let us rapidly run over the incidents of this, in some respects, the most remarkable expedition that ever entered Africa. Its first purpose, as we know, was to relieve, and if necessary bring away, Emin Pacha, the governor of the abandoned Equatorial Province of the Egyptian Sudan, which spread on each side of the Bahr-el-Jebel, the branch of the Nile that issues from the Albert Nyanza. Here it was supposed that he and his Egyptian officers and troops, and their wives and children, were beleaguered by the Mahdist hordes, and that they were at the end of their supplies. Emin Pacha, who as Eduard Schnitzer was born in Prussian Silesia, and educated at Breslau and Berlin as a physician, spent twelve years (1864–1876) in the Turkish service, during which he travelled over much of the Asiatic dominions of Turkey, indulging his strong tastes for natural history. In 1876 he entered the service of Egypt, and was sent up to the Sudan as surgeon on the staff of Gordon Pacha, who at that time governed the Equatorial Province. In 1878, two years after Gordon had been appointed governor-general of the whole Sudan, Emin Effendi (he had Moslemized himself) was appointed governor of the Equatorial Province, which he found completely disorganized and demoralized, the happy hunting-ground of the slave-raider. Within a few months Emin had restored order, swept out the slavers, got rid of the Egyptian scum who pretended to be soldiers, improved the revenue, so that instead of a large deficit there was a considerable surplus, and established industry and legitimate trade. Meantime the Mahdi had appeared, and the movement of conquest was gathering strength. It was not, however, till 1884 that Emin began to fear danger. It was in January of that year that Gordon went out to hold Khartoum; just a year later both he and the city fell before the Mahdist host. Emin withdrew with his officers and dependents, numbering probably about fifteen hundred, to Wadelai, in the south of the province, within easy reach of Albert Nyanza.

Rumors of the events in the Sudan after the fall of Khartoum reached this country; but no one outside of scientific circles seemed to take much interest in Emin till 1886. Rapidly, however, Europe became aware what a noble stand this simple *savant*, who had been foisted into the position of governor of a half-savage province, was making against the forces of the Mahdi, and how he refused to desert his post and his people. Towards the autumn of 1886 public feeling on the subject rose to such a height that the British Government, which was held to blame for the position in the Sudan, was compelled to take action. Our representative at Zanzibar, as early as August of that year, instituted inquiries as to the possibility of a relief expedition, but in the end, in dread of international complications, it was decided that a government expedition was impracticable. In this dilemma, Sir (then Mr.) William Mackinnon, chairman of the British India Steam Navigation Company, whose connection with East Africa is of old standing, came forward and offered to undertake the responsibility of getting up an expedition.

The Emin Pacha Relief Committee was formed in December, 1886, and government did all it could to aid, short of taking the actual responsibility. Mr. H. M. Stanley generously offered his services as leader, without fee or reward, giving up many lucrative engagements for the purpose. No time was lost. The sum of £20,000 had been subscribed, including £10,000 from the Egyptian Government. Mr. Stanley returned from America to England in the end of December; by the end of January he had made all his preparations, selecting nine men as his staff, including three English officers and two surgeons, and was on his way to Zanzibar, which was reached on Feb. 21. On the 25th the expedition was on board the "Madura," bound for the mouth of the Kongo, by way of the Cape: nine European officers, sixty-one Sudanese, thirteen Somalis, three interpreters, 620 Zanzibaris, the famous Arab slaver and merchant, Tippo-Tip, and 407 of his people.

The mouth of the Kongo was reached on March 18; there the expedition was transshipped into small vessels, and landed at Matadi, the limit of navigation on the lower river. From Matadi there was a march of 200 miles, past the cataracts to Stanley Pool, where the navigation was resumed. The troubles of the expedition began on the Kongo itself.

The question of routes was much discussed at the time of organizing the expedition, the two that found most favor being that from the east coast through Masai-land and round by the north of Uganda, and that by the Kongo. Into the comparative merits of these two routes we shall not enter here. For reasons which were satisfactory to himself, — and no one knows Africa better, — Mr. Stanley selected the Kongo route; though had he foreseen all that he and his men would have to undergo he might have hesitated. As it was, the expedition, which it was thought would be back in England by Christmas, 1887, only reached the coast in November, 1889. But the difficulties no one could have foreseen, the region traversed being completely unknown, and the obstacles encountered unprecedented even in Africa. Nor, when the goal was reached, was it expected that months would be wasted in persuading Emin and his people to quit their exile. Not the keenest-eyed of African explorers could have foreseen all this.

Want of sufficient boat accommodation, and a scarcity of food almost amounting to famine, hampered the expedition terribly on its way up the Kongo. The mouth of the Aruvimi, the real starting-point of the expedition, some 1,500 miles from the mouth of the Kongo, was not reached by Mr. Stanley and the first contingent till the beginning of June, 1887. The distance from here in a straight line to the nearest point of the Albert Nyanza is about 450 miles; thence it was believed communication with Emin would be easy, for he had two steamers available. But it was possible that a détour would have to be made towards the north so as to reach Wadelai direct, for no one knew the conditions which prevailed in the country between the Aruvimi mouth and the Albert Nyanza. As it was, Mr. Stanley took the course to the lake direct, but with many a circuit and many an obstruction, and at a terrible sacrifice of life. An intrenched camp was established on a bluff at Yambuya, about fifty miles up the left bank of the Aruvimi. Major Barttelot was left in charge of this, and with him Dr. Bonny, Mr. Jameson, Mr. Rose Troup, Mr. Ward, and 257 men; the rear column was to follow as soon as Tippo-Tip provided the contingent of five hundred natives which he had solemnly promised. Although the whole of the men had not come up, yet every thing seemed in satisfactory order; explicit instructions were issued to the officers of the rear column; and on June 28, 1887, Mr. Stanley, with a contingent consisting of 389 officers and men, set out to reach Emin Pacha. The officers with him were Captain Nelson, Lieutenant Stairs, Dr. Parke, and Mr. Jephson.

Five miles after leaving camp the difficulties began. The expedition was face to face with a dense forest of immense extent, choked with bushy undergrowth, and obstructed by a network of creepers through which a way had often to be cleaved with the axes. Hostile natives harassed them day after day; the paths were studded with concealed spikes of wood; the arrows were poisoned; the natives burned their villages rather than have dealings with the intruders. Happily the river, when it was again struck, afforded relief, and the steel boat proved of service, though the weakened men found the portages past the cataracts a great trial. It was fondly hoped that here at least the Arab slaver had not penetrated; but on Sept. 16 two hundred miles from Yambuya, making 340 miles of actual travel, the slave camp of Ugarowwa was reached, and here the treatment was even worse than when fighting the savages of the forest. The brutalities practised on Stanley's men cost many of them their lives. A month later the camp of another Arab slaver was reached, Kilinga Longa, and there the treatment was no better. These so-called Arabs, whose

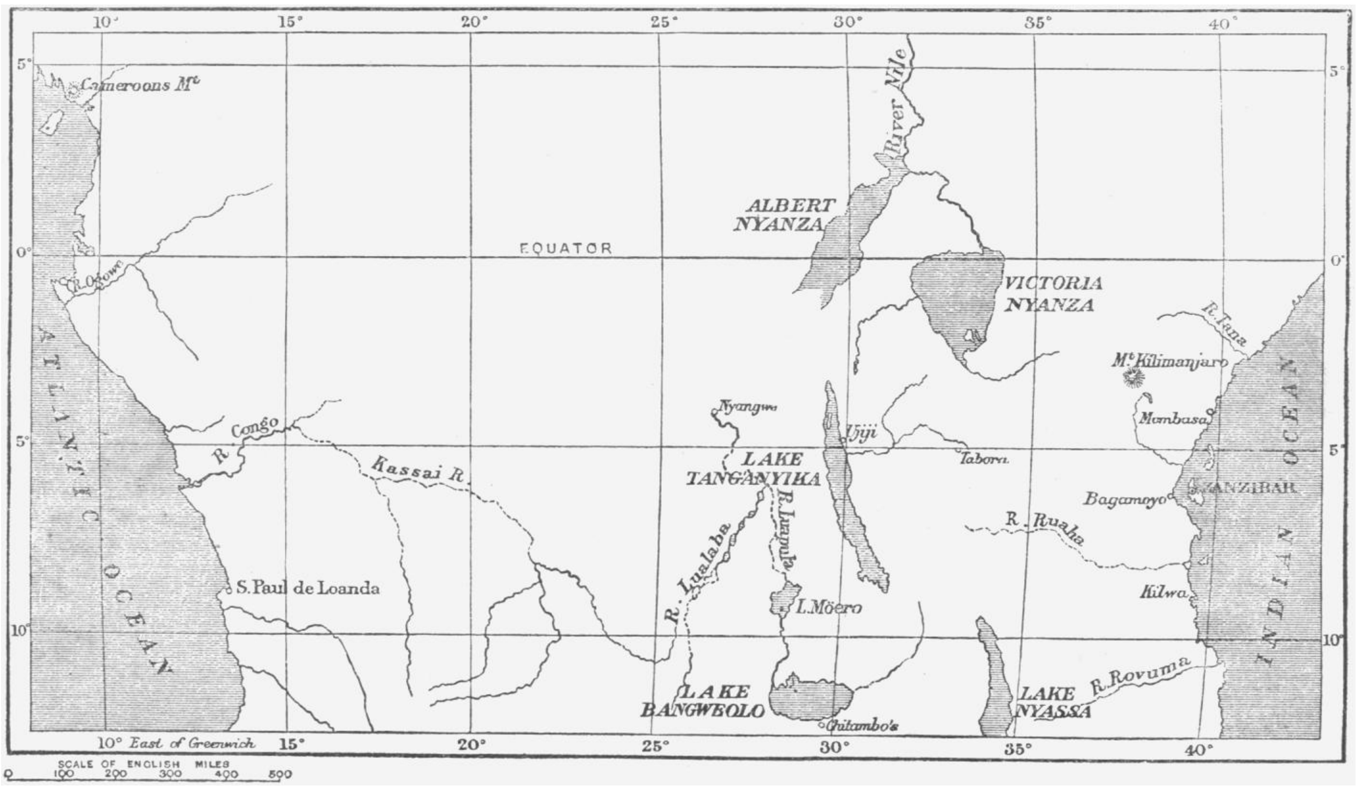
caravans consist mainly of the merciless Manyuema, from the country between Tanganyika and Nyangwé, had laid waste a great area of the region to be traversed by the expedition, so that between Aug. 31 and Nov. 12 every man was famished; and when at last the land of devastation was left behind, and the native village of Ibwiri entered, officers and men were reduced to skeletons. Out of the 389 who started, only 174 entered Ibwiri, the rest dead, or missing, or left behind, unable to move, at Ugarowwa's. So weak was everybody that seventy tons of goods and the boat had to be left at Kilinga Longa's with Captain Nelson and Surgeon Parke.

A halt of thirteen days at Ibwiri, with its plenty of fowls, bananas, corn, yams, beans, restored everybody; and 173 sleek and robust men set out for the Albert Nyanza on Nov. 24. A week later the gloomy and dreaded forest suddenly ended; the open country was reached; the light of day was unobstructed; it was an emergence from darkness to light. But the difficulties were not over; some little fighting with the natives on the populous plateau was necessary before the lake could be reached. On the 12th the edge of the long slope from the Kongo to Lake Albert was attained, and suddenly the eyes of all were gladdened by the sight of the lake lying some three thousand feet almost sheer below. The expedition itself stood at an altitude of 5,200 feet above the sea. But the end was not yet. Down the expedition marched to the south-west corner of the lake, where the Kakongo natives were unfriendly. No Emin Pacha had been heard of; there was no sign even that he knew of Stanley's coming, or that the messenger from Zanzibar had reached him. The only boat of the expedition was at Kilinga Longa's, 190 miles away. Of the men, 94 were behind sick at Ugarowwa's and Kilinga Longa's; only 173 were with Stanley; 74 of the original 341 were dead or missing; and, moreover, there was anxiety about the rear column.

Stanley's resolution was soon taken. Moving to the village of Kavalli, some distance up the steep slope from the lake, the party began a night march on Dec. 15, and by Jan. 7 they were back at Ibwiri. Here Fort Bodo, famous in the records of the expedition, was built. The men were brought up from the rear, and on April 7 Stanley, with Jephson and Parke, once more led the expedition to Lake Albert, this time with the boat and fresh stores. Meantime, Stanley himself was on the sick-list for a month. This time all the natives along the route were friendly and even generous, and on April 22 the expedition reached the chief Kavalli, who delivered to Stanley a letter wrapped in American cloth. The note was from Emin, and stated that he had heard rumors of Stanley's presence in the district; it begged Stanley to wait until Emin could communicate with him. The boat was launched, and Jephson set off to find Emin. On the 29th the "Khedive" steamer came down the lake with Emin, the Italian Casati, and Jephson on board. The great object of the expedition seemed at last to be all but fulfilled.

But the end was not yet. There was the party at Fort Bodo; there were the sick further back with whom Lieutenant Stairs had not returned when Stanley left the fort; and, above all, there was the rear column left at Yambuya with Major Barttelot. It would take some time for Emin to bring down all his people from Wadelai and other stations. So after spending over three weeks with the vacillating Emin, Stanley, on May 25, was once more on the march back to Fort Bodo to bring up all hands. He left Jephson, three Sudanese, and two Zanzibaris with Emin, who gave him 102 natives as porters, and three irregulars to accompany him back. Fort Bodo was reached on June 8, and was found in a flourishing state, surrounded by acres of cultivated fields. But of the fifty-six men left at Ugarowwa's only sixteen were alive for Lieutenant Stairs to bring to Fort Bodo. As there was no sign of the rear column nor of the twenty messengers sent off in March with letters for Major Barttelot, Stanley felt bound to retrace his steps through the terrible forest. This time he was better provisioned, and his people (212) escaped the horrors of the wilderness.

Fort Bodo was left on June 16, Stanley letting all his white companions remain behind. Ugarowwa's camp was deserted, and he himself, with a flotilla of fifty-seven canoes, was overtaken far down the river on Aug. 10, and with him seventeen of the carriers sent off to Major Barttelot in March; three of their number had been killed. On the 17th the rear column was met with at Bonalya, eighty miles above Yambuya, and then for the first time Stanley learned of the terrible disaster that had befallen it — Barttelot shot by the Manyuema, Jameson gone down the Kongo (only to die), Ward away, and Troup invalided home. No one but Dr. Bonny: of the 257 men only seventy-two remaining, and of these only fifty-two fit for service. No wonder Mr. Stanley felt too sick to write the details; and until we have the whole of the evidence it would

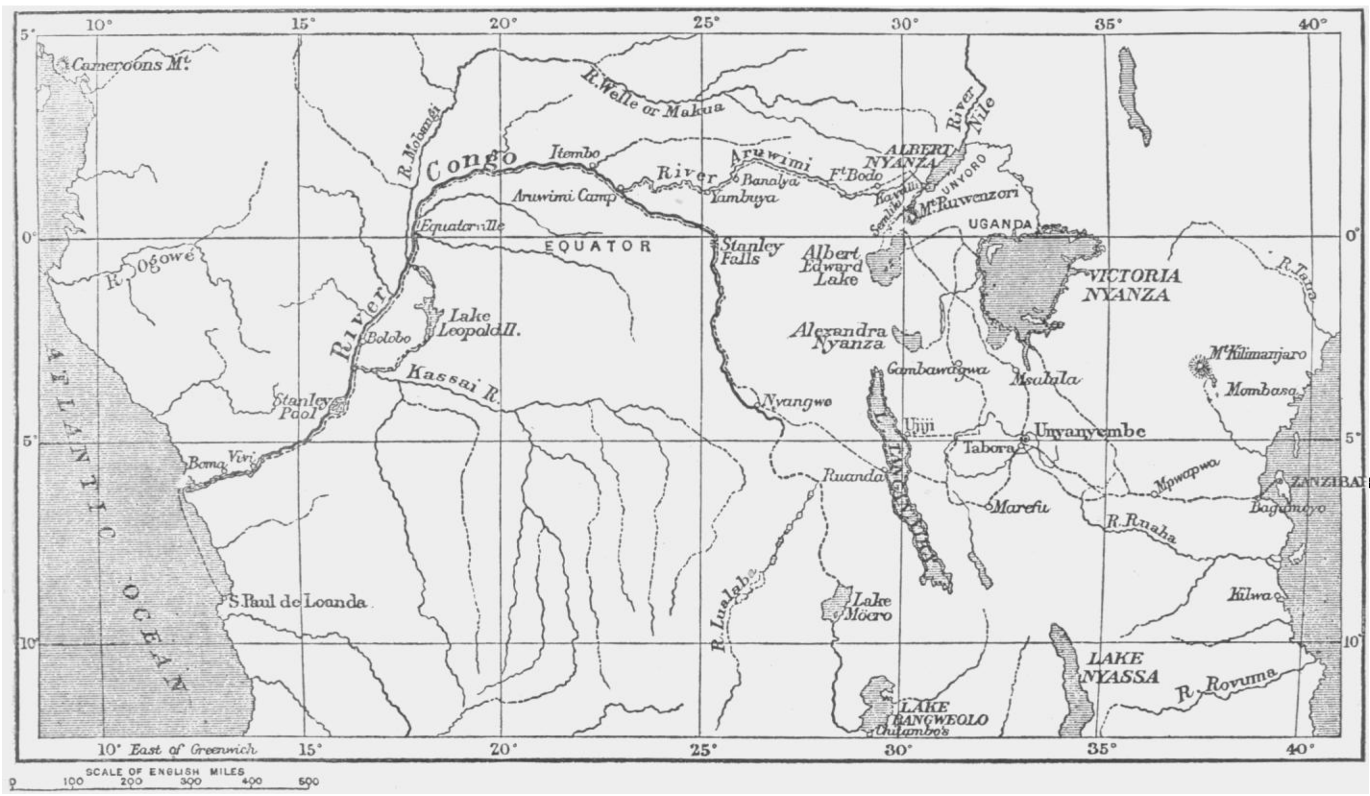


CENTRAL AFRICA, BEFORE STANLEY.

be unfair to pronounce judgment. One thing we may say: we know, from Mr. Werner's recently published "River Life on the Congo," that before Major Barttelot left Yambuya to follow Stanley it was known to Mr. Werner, to more than one Belgian officer, to several natives, and to the Manyuema people with Barttelot, that instructions had been given by Tippo-Tip to these last to shoot Major Barttelot if he did not treat them well. Yet no one cared to warn the major, and he was allowed to depart to his almost certain fate. The thing is too sickening to dwell upon. It was at this stage that Stanley sent home his first letters, which reached England on April 1, 1889, twenty months after he started from the Aruvimi, and over two years after he left England. The relief was intense; all sorts of sinister rumors had been floated, and most people had given up the expedition for lost.

Once more back through the weary forest, with the expedition re-organized. A new route was taken to the north of the river through a region devastated by the Arab slavers; and here the expedition came near to starvation, but once more Fort Bodo was reached, on Dec. 20. Here things were practically as Stanley had left them; there was no sign of Emin, though he had promised to come to the fort. The combined expedition marched onwards, and Mr. Stanley, pushing on with a contingent, reached the lake for the third time, on Jan. 18, only to learn that Emin and Jephson had been made prisoners by Emin's own men; the Mahdists had attacked the station and created a panic, and all was disorganization and vacillation. At last, however, the chief actors in this strange drama were together again: and Mr. Stanley's account of Emin's unstable purpose; the long arguments with the Pacha to persuade him to come to a decision; the ingratitude and treachery of the Egyptians; the gathering of the people and their burdensome goods and chattels preparatory to quitting the lake, — these and many other details are fresh in our memories from Stanley's own letters. But the main purpose of the expedition was accomplished, at however terrible a cost, and however disappointing it was to find that after all Emin was reluctant to be "rescued." When the start was made from Kavalli's, on April 10 last, fifteen hundred people in all were mustered. An almost mortal illness laid Stanley low for a month shortly after the start, and it was May 8 before the huge caravan was fairly under way. Some fighting had to be done with the raiders from Unyoro, but on the whole the homeward march was comparatively free from trouble, and full of interest; and on Dec. 6 Mr. Stanley once more entered Zanzibar, which he had left two years and ten months before. Such briefly are some of the incidents of the rescue expedition; let us now as briefly sum up the geographical results.

When Stanley left for Africa in January, 1887, there remained one of the great problems of African hydrography still unsolved, what is known as the problem of the Wellé. Schweinfurth and Junker had come upon a river at some points which seemed to rise in the neighborhood of the Albert Nyanza, and appeared to flow in a north-west direction. The favorite theory at the time was that the river Wellé was really the upper course of the Shari, which runs into Lake Chad far away to the north-west. But as the Kongo and its great feeders on the north, and the lay of the land in that direction, became better known, it began to be conjectured that after all the Wellé might send its waters to swell the mighty volume of the great river. Stanley, I know, hoped that, among other geographical work, he might be able to throw some light on the course of this puzzling river. But, as we see now, the cares and troubles that fell upon him prevented him going much out of the way to do geographical work. While, however, Stanley was cleaving his way through the tangled forest, Lieutenant Van Géle, one of the Free State officers, proved conclusively that the Wellé was really the upper course of the Mobangi, one of the largest northern tributaries of the Kongo. But another and kindred problem Stanley was able to solve. Before his journey, the mouth of the river Aruvimi was known; the great naval battle which he fought there on his first descent of the river is one of the most striking of the many striking pictures in the narrative of that famous journey. But beyond Yambuya its course was a blank. The river, under various names, "Ituri" being the best known, led him almost to the brink of the Albert Nyanza. One of its upper contributories is only ten minutes' walk from the brink of the escarpment that looks down upon the lake. With many rapids, it is for a great part of its course over five hundred yards wide, with groups of islands here and there. For a considerable stretch it is navigable, and its entire length, taking all its windings into account, from its source to the Kongo, is eight hundred miles. One of its tributaries turns out to be another river which Junker met farther north, and whose destination was a puzzle, the Nepoko.



CENTRAL AFRICA, AFTER STANLEY.

Thus this expedition has enabled us to form clearer notions of the hydrography of this remarkable region of rivers. We see that the sources of the Kongo and the Nile lie almost within a few yards of each other. Indeed, so difficult is it to determine to which river the various waters in this region send their tribute, that Mr. Stanley himself, in his first letter, was confident that the southern Lake Albert belonged to the Kongo, and not to the Nile system; it was only actual inspection that convinced him he was mistaken. How it is that the Ituri or the Aruvimi and other rivers in the same region are attracted to the Kongo and not to the Nile is easily seen from Mr. Stanley's graphic description of the lay of the country between the Kongo and the Albert Nyanza. It is, he says, like the glacis of a fort, some 350 miles long, sloping gradually up from the margin of the Kongo (itself at the Aruvimi mouth 1,400 feet above the sea), until ten minutes beyond one of the Ituri feeders it reaches a height of 5,200 feet, to descend almost perpendicularly 2,900 feet to the surface of the lake, which forms the great western reservoir of the Nile.

But when the term "glacis" is used, it must not be inferred that the ascent from the Kongo to Lake Albert is smooth and unobstructed. The fact is that Mr. Stanley found himself involved in the northern section of what is probably the most extensive and densest forest region in Africa. Livingstone spent many a weary day trudging its gloomy recesses away south at Nyangwé on the Lualaba. It stretches for many miles north to the Monbuttu country. Stanley entered it at Yambuya, and tunnelled his way through it to within fifty miles of the Albert Nyanza, when it all of a sudden ceased and gave way to grassy plains and the unobstructed light of day. How far west it may extend beyond the Aruvimi he cannot say; but it was probably another section of this same forest region that Mr. Paul du Chaillu struck some thirty years ago, when gorilla-hunting in the Gaboon. Mr. Stanley estimates the area of this great forest region at about three hundred thousand square miles, which is more likely to be under than over the mark. The typical African forest, as Mr. Drummond shows in his charming book on "Tropical Africa," is not of the kind found on the Aruvimi, which is much more South American than African. Not even in the "great sponge" from which the Zambesi and the Kongo draw their remote supplies do we meet with such impenetrable density. Trees scattered about as in an English park in small open clumps form, as a rule, the type of "forest" common in Africa; the physical causes which led to the dense packing of trees over the immense area between the Kongo and Nile lakes will form an interesting investigation. Mr. Stanley's description of the great forest region, in his letter to Mr. Bruce, is well worth quoting: —

"Take a thick Scottish copse, dripping with rain; imagine this copse to be a mere undergrowth, nourished under the impenetrable shade of ancient trees, ranging from 100 to 180 feet high; briers and thorns abundant; lazy creeks meandering through the depths of the jungle, and sometimes a deep affluent of a great river. Imagine this forest and jungle in all stages of decay and growth — old trees falling, leaning perilously over, fallen prostrate; ants and insects of all kinds, sizes, and colors murmuring around; monkeys and chimpanzees above, queer noises of birds and animals, crashes in the jungle as troops of elephants rush away; dwarfs with poisoned arrows securely hidden behind some buttress or in some dark recess; strong, brown-bodied aborigines with terribly sharp spears, standing poised, still as dead stumps; rain pattering down on you every other day in the year; an impure atmosphere, with its dread consequences, fever and dysentery; gloom throughout the day, and darkness almost palpable throughout the night; and then if you will imagine such a forest extending the entire distance from Plymouth to Peterhead, you will have a fair idea of some of the inconvenience endured by us from June 28 to Dec. 5, 1887, and from June 1, 1888, to the present date, to continue again from the present date till about Dec. 10, 1888, when I hope then to say a last farewell to the Kongo Forest."

Mr. Stanley tries to account for this great forest region by the abundance of moisture carried over the continent from the wide Atlantic by the winds which blow landward through a great part of the year. But it is to be feared the remarkable phenomenon is not to be accounted for in so easy a way. Investigation may prove that the rain of the rainiest region in Africa comes not from the Atlantic, but the Indian Ocean, with its moisture-laden monsoons. And so we should have here a case analogous to that which occurs in South America, the forests of which resemble in many features those of the region through which Mr. Stanley has passed.

But the forest itself is not more interesting than its human denizens. The banks of the river in many places are studded with large villages, some, at least, of the native tribes being cannibals. We are here on the northern border of the true negro peoples, so that when the subject is investigated the Aruvimi savages may be found to be much mixed. But unless Europe promptly intervenes, there will shortly be few people left in these forests to investigate. Mr. Stanley came upon two slave-hunting parties, both of them manned by the merciless people of Manyuema. Already great tracts have been turned into a wilderness, and thousands of the natives driven from their homes. From the ethnologist's point of view the most interesting inhabitants of the Aruvimi forests are the hostile and cunning dwarfs, or rather pygmies, who caused the expedition so much trouble. No doubt they are the same as the Monbuttu pygmies found farther north, and essentially similar to the pygmy population found scattered all over Africa, from the Zambesi to the Nile, and from the Gaboon to the east coast. Mr. Du Chaillu found them in the forests of the west thirty years ago, and away south on the great Sankuru tributary of the Kongo Major Wissmann and his fellow-explorers met them within the past few years. They seem to be the remnants of a primitive population rather than stunted examples of the normal negro. Around the villages in the forest, wherever clearings had been made, the ground was of the richest character, growing crops of all kinds. Mr. Stanley has always maintained that in the high lands around the great lakes will be found the most favorable region for European enterprise; and if in time much of the forest is cleared away, the country between the Kongo and Lake Albert might become the granary of Africa.

To the geographer, however, the second half of the expedition's work is fuller of interest than the first. Some curious problems had to be solved in the lake region, problems that have given rise to much discussion. When in 1864 Sir Samuel Baker stood on the lofty escarpment that looks down on the east shore of the Albert Nyanza, at Vacovia, the lake seemed to him to stretch illimitably to the south, so that for long it appeared on our maps as extending beyond 1° south latitude. When Stanley, many years later, on his first great expedition, after crossing from Uganda, came upon a great bay of water, he was naturally inclined to think that it was a part of Baker's lake, and called it Beatrice Gulf. But Gessi and Mason, members of Gordon Pacha's staff, circumnavigated the lake later on, and found that it ended more than a degree north of the equator. So when Stanley published his narrative he made his "Beatrice Gulf" a separate lake lying to the south of the Albert Nyanza. Mr. Stanley saw only a small portion of the southern lake, Muta Nzigé, but in time it expanded and expanded on our maps, until there seemed some danger of its being joined on to Lake Tanganyika. Emin himself, during his twelve years' stay in the Sudan, did something towards exploring the Albert Nyanza, and found that its southern shore was fast advancing northwards, partly owing to sediment brought down by a river, and partly due to the wearing away of the rocky bed of the Upper Nile, by which much water escaped, and the level of the lake subsided. Thus, when Baker stood on the shore of the lake in 1864, it may well have extended many miles farther south than it does now. But where did the river come from that Mason and Emin saw running into the lake from the south? As was pointed out above, Stanley at first thought it could not come from his own lake to the south, which he believed must send its waters to the Kongo. But all controversy has now been ended. During the famous exodus of the fifteen hundred from Kavalli to the coast, the intensely interesting country lying between the northern lake, Albert, and the southern lake, now named Albert Edward, was traversed. Great white grassy plains stretch away south from the shores of Lake Albert, which under the glitter of a tropical sun might well be mistaken for water; evidently they have been under water at a quite recent period. But soon the country begins to rise, and round the base of a great mountain boss the river Semliki winds

its way through its valley, receiving through the picturesque glens many streams of water from the snows that clothe the mountain-tops. Here we have a splendid country, unfortunately harassed by the raids of the Wanyoro, in dread of whom the simple natives of the mountain-side often creep up to near the limit of snow. Up the mountain, which Lieutenant Stairs ascended for over ten thousand feet, blackberries, bilberries, violets, heaths, lichens, and trees that might have reminded him of England flourish abundantly. Here evidently we have a region that might well harbor a European population. The mountain itself, Ruwenzori, a great boss with numerous spurs, is quite evidently an extinct volcano, rising to something like nineteen thousand feet, and reminding one of Kilima Njaro, farther to the east. It is not yet clear whether it is the same mountain as the Gordon Bennett seen by Stanley in his former expedition, though the probability is that, if distinct, they belong to the same group or mass. Apart from the mountain the country gradually ascends as the Semliki is traced up to its origin in Lake Albert Edward. Mr. Stanley found that, after all, the southern Nyanza belongs to the great Nile system, giving origin to the farthest south-west source of Egypt's wonderful river, which we now know receives a tribute from the snows of the equator.

The southern lake itself is of comparatively small dimensions, probably not more than forty-five miles long, and is nine hundred feet above the northern Lake Albert. Mr. Stanley only skirted its west, north, and east shores, so that probably he has not been able to obtain complete data as to size and shape. But he has solved one of the few remaining great problems in African geography. The two lakes lie in a trough, the sides of which rise steeply in places three thousand feet, to the great plateaus that extend away east and west. This trough, from the north end of Lake Albert to the south end of Lake Albert Edward, is some two hundred and sixty statute miles in length. About one hundred miles of this is occupied by the former lake, forty-five by the latter, and the rest by the country between, where the trough, if we may indulge in an Irishism, becomes partly a plain, and partly a great mountain mass. But this trough, or fissure, a glance at a good map will show, is continued more or less south and south-east in Lakes Tanganyika and Nyassa, which are essentially of the same character as Lakes Albert and Albert Edward, and totally different from such lakes as Victoria Nyanza and Bangweolo. Here we have a feature of the greatest geographical interest, which still has to be worked out as to its origin.

There is little more to say as to the geographical results of the Emin Pacha Relief Expedition. There are many minute details of great interest, which the reader may see for himself in Mr. Stanley's letters, or in his forthcoming detailed narrative. In his own characteristic way, he tells of the tribes and peoples around the lakes, and between the lakes and the coast; and it was left for him on his way home to discover a great south-west extension of Victoria Nyanza, which brings that lake within one hundred and fifty miles of Lake Tanganyika. The results which have been achieved have been achieved at a great sacrifice of life and of suffering to all concerned; but no one, I am sure, will wish that the work had been left undone. The few great geographical problems in Africa that Livingstone had to leave untouched, Stanley has solved. Little remains for himself and others in the future beyond the filling-in of details; but these are all-important, and will keep the great army of explorers busy for many years, if not for generations.

USEFUL PLANTS IN GUATEMALA.

IN a report on the trade, commerce, and industries of the Republic of Guatemala for 1888, the British Consul to that republic draws attention to the various vegetable products cultivated in the country. Coffee is described as the most important agricultural product, and, from its excellent quality, fetches a high price in the market. The area of land planted has possibly doubled in the last few years, and owing to failure in the last year's crop in Brazil, and the consequent rise in the value of the product, an unusually large acreage of fresh land is now being planted, and greater care taken with the present estates, many old plantations being renewed and added to. It is expected that next year, or the year after, 1,000,000 quintals will be produced, bringing, exclusive of consumption, a wealth of $11,500,000 to $12,500,000 to the country. There is still a quantity of good land available for purchase. Sowing is generally done in June; and when about seven inches high, the young plants are transplanted into nurseries, watered in the dry season, and protected from the sun until ready to be planted out. About 100,000 quintals of coffee are yearly consumed in the country.

Sugar stands next among the most important vegetable products. Cacao cultivated in Guatemala is of superior quality, and at one time it was an important article of export, but has of late years greatly fallen off; and at the present time only about 400,000 pounds are produced, scarcely more than is required for interior consumption. The government are encouraging farmers to turn their attention to this branch of culture, and some new plantations have been made. The seeds have been distributed in considerable quantities in various parts of the south, the sowing has shown good results, and it is expected that the cultivation of this valuable plant will be much increased. It takes about six years from the time the seed is sown before a crop is produced; but after that period each shrub will yield one pound three times a year, and last for a hundred years. There is little cost in cultivating or gathering, and no machinery is required; so that, though there is some time to wait before new plantations give any return, the ultimate profit is considerable. A slightly earlier result may be obtained by surrounding the plantation with lime or orange trees, well preparing the land, and shading the plants with suitable trees.

A quantity of coca-seed (*Erythroxylon coca*) was last year imported from Peru for distribution among the people in a suitable zone for its growth; but the result was unsatisfactory, from the bad quality of the seed, and fresh means are being taken to extend the cultivation of this plant.

Pepper and cinnamon are grown in the department of Alta Verapaz. Good seed has been imported from Ceylon, and planting is extending in that fertile district, while satisfactory results have been obtained in the department of Escuintla, where a few plantations have been made.

Rice is a very large article of consumption in the republic, and the government have established at San José works for perfecting machinery to separate the husk.

Good tobacco is grown, but little attention is paid to the mode of preparing it. The production is being encouraged by the gratuitous circulation of the best seed procurable from Havana, the United States, and Sumatra, and many new plantations are being made.

In spite of endeavors made to protect the rubber or caoutchouc trees, the production of rubber continues to decrease, and only in Verapaz and Peten are trees found in any quantity; while the growers show no signs of replacing those that are worn out. Holes are made in the stems to extract the sap, and alum, saltwort, or some other juice, used to coagulate it. It might be made a profitable industry if proper knowledge and appliances were brought to bear. A few new plantations are being made in one or two low-lying farms; about 3,000 quintals are annually exported. The plant yielding Guatemala rubber is *Castilloa elastica*.

Among other products grown are maize, beans, peas, and potatoes in sufficient quantity for home consumption; sarsaparilla and vanilla grow wild on the mountains all over the country. The price of sarsaparilla has fallen greatly. There was scarcely any exported last year, and in 1887 it only reached the value of $8,105. The quality of the vanilla is good, but, though it figures as an export, it is not cultivated for that purpose.

Banana-planting in the east is occupying much attention as a profitable industry, some 200,000 trees being now yearly planted for the supply of the United States market. About 120,000 bunches are at present exported annually. Peruvian (*Bœhmeria nivea*) was also introduced three years ago, and more than 600,000 shoots were distributed with a view to its general cultivation, but exportation of the fibre has not met with satisfactory results. Indigo-works are subsiding in the country, though a few still exist in the east, and means are being taken to encourage them. Indigo was exported to the value only of $465 in 1888, though formerly a very large trade was done in it. The industry in cochineal has almost entirely disappeared: for thirty years it was the principal article of export, and now the little produced is used for native consumption, aniline dyes having ruined the trade.

HEALTH MATTERS.

THE BLOOD IN PHTHISIS AND CANCER. — Dr. G. Neubert has examined the blood in twenty-four cases of phthisis at various stages, says *The Lancet*, and found that in nine the number of corpuscles was normal, in three it was above, and in twelve more or less below, the average. On the whole, there was an average diminution of about eight per cent. The increase noted in three cases might perhaps be attributed to profuse night-sweats. The hæmoglobin showed a reduction to seventy-three per cent in the females, and eighty-five per cent in the males. There was no notable change in the number of leucocytes, but it was observed that multi-enucleated forms predominated. In five cases of cancer of the œsophagus, and four of cancer of the stomach, there was an invariable diminution in the number of red corpuscles, and also notably of hæmoglobin. It is inferred that the hæmoglobin, being the more "sensitive" element of red corpuscles, is more profoundly affected in cachexia than the stroma of the corpuscles. A distinction was made between the anæmic and marasmic types of cancer, the latter exhibiting an average reduction of thirteen per cent of corpuscles, while the hæmoglobin fell to eighty-seven per cent of the normal; the former showing a corpuscular reduction of thirty-five per cent, while the hæmoglobin was as much as seventy per cent.

THE "NORMAL" DIET. — According to Dr. G. Munro Smith, in the *Bristol Medico-Chirurgical Journal*, the daily destructive metabolism, which is the great criterion of work done, does not vary much among different occupations. Premising that he does not consider moderate over-eating injurious, he finds that very many men eat considerably more than the most liberal tables: it is not an uncommon thing for an average-sized man on very moderate work to eat twenty-five or twenty-seven ounces of chemically dry food a day. Women eat much less than men, after making allowances for differences in weight and work. Where a man eats nineteen ounces, a woman of the same weight and of active habits eats only fourteen or fifteen ounces. On a diet from which all meat is excluded, he has found that twelve to thirteen ounces *per diem* will comfortably feed a hard-working man. A moderate amount of stimulants appears to increase the average: moderately free drinking diminishes it. A diet consisting of one part of nitrogenous to seven or eight non-nitrogenous is a good combination: it is greatly exceeded on the nitrogenous side by the majority of men and women, especially the former. A diet of twelve to fourteen ounces of chemically dry food, digestible, with the ingredients in proper proportion, is sufficient to keep in good health an average-sized man on moderate work. The majority of people (in England) eat literally twice as much as this.

TOLERANCE OF OPERATIONS ON THE LIVER. — Professor Ponfick of Breslau has been for a number of years engaged in making experiments in regard to the relation between the liver and certain anomalies in the formation of blood. In the course of these investigations he has made some striking discoveries, which, although not directly connected with the object of his investigations, are yet of great importance. One of the most curious results of his experiments has been the discovery that the animal functions may be conducted without serious disturbance even after the loss of a very large portion of so important an organ as the liver, says *The Medical and Surgical Reporter* of Oct. 12, 1889. In some cases, operating with strict antisepsis, he succeeded in removing as much as three-fourths of the liver, either at several sittings or in one single operation; and the animals upon which he experimented did not lose their lives, nor seem to be seriously disturbed in their health. In hundreds of experiments, in which he removed sometimes one lobe and sometimes another, the animals remained, in a considerable number of cases, perfectly well for months, and even for as long as a year. Clinical experience has already taught us that the whole of the liver is not absolutely essential to health, because large portions of this organ have been practically destroyed — as in the case of echinococcus and profound fatty infiltration — without any disturbance of the general functions of the body. But this, as Ponfick says, is hardly to be compared with the sudden and immediate removal of large portions of an organ which is supposed to be so important to health. The explanation of this curious fact seems to be that the liver has a wonderful power of reproduction. Ponfick found, that, within a few days after the removal of portions of the liver, the work of its reproduction began, and that it proceeded with great rapidity to completion. In certain cases he found that within a period of a few weeks as much was reproduced as had been removed; that is, twice as much as had been left behind. These investigations have an interest altogether outside of that which is absolutely scientific, because it cannot fail to influence the development of abdominal surgery, if it is understood that large portions of the liver may be removed without serious danger to life.

LEPROSY HERE AND ELSEWHERE. — Dr. Hansen, the Norwegian discoverer of the bacillus of leprosy, came over to this country a while ago to trace the history of leper immigrants who had settled in Wisconsin, Minnesota, and Dakota. Of 160 original leper immigrants, he was able to find only 13; a few more may be living, but nearly 147 are dead. Of all their descendants, so far as great-grandchildren, not one has become a leper. In this country the disease does not increase, nor does it appear to be hereditary. The failure to spread here is thought to be due to the improved conditions of living which the immigrants are able to secure on this side of the ocean. The *Sanitary Inspector*, in speaking of a leper lately found at Brentwood, Eng., says that many persons believe that leprosy has entirely disappeared from England, yet there has probably never been a year in which a score of lepers could not be produced, and that, though England used to have lepers enough, leprosy has become a very rare disease since English homes and English roads have been kept clean.

PHTHISIS IN HIGH ALTITUDES. — From a report in the *Lancet* by Dr. L. Schrötter on the distribution of phthisis in Switzerland, it would seem that the inhabitants even of high altitudes are by no means so free from phthisis as we are wont to suppose. The tables of deaths for the eleven years 1876–86 show that phthisis is endemic in every part of Switzerland, not a single district being free from it. On the whole, the deaths from this cause are fewer in the high than in the low lying districts, but it cannot be said that the mortality from this cause is inversely proportionate to the altitude. Wherever there is a large industrial population, the phthisis mortality is considerable. Industrial populations always suffer much more than agricultural populations where the altitude is the same.

NOTES AND NEWS.

THE San Francisco *Bulletin* says that the California beet-sugar experiment is a success. Last year 2,000 acres were planted, and yielded 13,500 tons of sugar-beets, from which were extracted 1,650 tons of sugar. This was done at the Watsonville factory, which ran forty-seven days. The beets brought an average of five dollars a ton, and the farmers feel satisfied that they can raise them at a profit. They have guaranteed to greatly increase the acreage this year, and the output will probably be more than doubled.

— The United States consul at Bahia describes a substance called turfa, lately discovered in Brazil, at a place called Maratiu, about sixty miles south of Bahia. Turfa has been found to contain the main ingredient now extracted from it by distillation, viz., petroleum, or, as it is locally called, "brazolina" or "petroleo nacionale," besides paraffine, gasoline, and lubricating-oils resulting from the process. A company was formed, and the concession purchased. Machinery has been imported from England, and from four hundred to four hundred and fifty hands are employed at the mines. The company, it is stated, will manufacture fifty tons of candles per month; and if the enterprise should prove a success, it will probably interfere with the trade in kerosene, candles, and lubricating-oils which the United States now has with Brazil and with the countries south of Brazil.

— The thirty-seventh annual meeting of the American Society of Civil Engineers was held at the society's rooms in this city last week, beginning on the 15th. The society now has a total membership of 1,335. The Norman medal was awarded to Mr. Theodore Cooper, for a paper on American railroad-bridges; and the

Rowland prize, to Mr. James D. Schuyler, for a paper on the construction of the Sweetwater dam, near San Diego, Cal. An important report was submitted by the committee on impurities in domestic water-supply. In the opinion of the committee, the organization to inquire into the sources of impurities in drinking-water, and the methods of remedying them, should be a national one, and the work should properly be taken up by the American Society. The committee recommended that all printed information on this subject should gradually be collected and catalogued, and that the society should own and maintain a complete collection of such literature. The report was accepted. On the 16th about four hundred members of the society and invited guests paid a visit to the government torpedo station at Willet's Point, the Brooklyn navy yard, and other points of interest. The officers of the society for the ensuing year are as follows: president, William P. Shinn; vice-presidents, A. Fteley, Mendes Cohen; secretary and librarian, John Bogart; treasurer, George S. Greene, jun.; directors, Charles B. Brush, Theodore Voorhees, Robert Van Buren, William Ludlow, William G. Curtis.

— The American Society for Psychical Research, after existing for five years, with its headquarters in Boston, and publishing some six hundred pages of "Proceedings," at last, for pecuniary reasons, terminated its corporate existence on Jan. 14. The English society of the same name is heir to its documentary possessions, and is to keep Dr. Richard Hodgson, late secretary of the American society, as its own secretary in America. A majority of the associates of the American society have joined the English society, forming the nucleus of an American branch. Professors S. P. Langley of Washington, H. P. Bowditch of Boston, and W. James of Cambridge, are appointed vice-presidents of the Society for Psychical Research in America; but, apart from their advisory functions, there is no "organization" here, — a circumstance which will doubtless contribute to economy and efficiency of work. It is to be hoped that a solid moral and pecuniary support to the society may be extended from this country. The annual assessment of American associates is three dollars. They receive for this the published "Proceedings," which appear quarterly, and the monthly "Journal," printed for circulation in the society only. Those who wish may become full "members" of the English society, with voting and other privileges, by the annual payment of ten dollars. Meetings of the branch will be held periodically for the readings of papers and discussion. Those who desire to join the society or to obtain information should address the secretary, R. Hodgson, No. 5 Boylston Place, Boston.

— In accordance with the intention of its honored founder, the trustees of the Missouri Botanical Garden, St. Louis, propose to provide adequate theoretical and practical instruction for young men desirous of becoming gardeners. It is not intended at present that many persons shall be trained at the same time, nor that the instruction so planned shall duplicate the excellent courses in agriculture now offered by the numerous State colleges of the country, but that it shall be quite distinct, and limited to what is thought to be necessary for training practical gardeners. Scholarships, not exceeding six in number, will be awarded by the director of the garden, prior to the first of April next. Applications for scholarships, to receive consideration, must be in the hands of the director not later than the first day of March. During the first year of their scholarship, garden pupils will work at the practical duties of the garden nine or ten hours daily, according to the season, the same as regular employees of the garden, and will also be expected to read the notes and articles referring to the subject of their work, in one or more good journals. In the second year, in addition to five hours' daily work of the same sort, they will be given instruction and will be required to do thorough reading in vegetable-gardening, flower-gardening, small-fruit culture, and orchard-culture, besides keeping the run of the current papers. In the third year, in addition to five hours of daily labor, they will be instructed and given reading in forestry, elementary botany, landscape-gardening, and the rudiments of surveying and draining, and will be required to take charge of clipping or indexing some department of the current gardening papers for the benefit of all. In the fourth year, besides the customary work, they will study the botany of weeds, garden vegetables, and fruits, in addition to assisting in the necessary indexing or clipping of papers, etc., and will be taught simple book-keeping, and the legal forms for leases, deeds, etc. The course for the fifth year, in addition to the customary work, will include the study of vegetable physiology, economic entomology, and fungi, especially those which cause diseases of cultivated plants; and each pupil will be expected to keep a simple set of accounts pertaining to some department of the garden. In the sixth year, in addition to the manual work, pupils will study the botany of garden and green-house plants, of ferns, and of trees in their winter condition, besides the theoretical part of special gardening, connected with some branch of the work that they are charged with in the garden. From time to time, changes in this course will be made, as they shall appear to be desirable, and the effort will be made to give the best theoretical instruction possible in the various subjects prescribed; but it is not intended to make botanists or other scientific specialists of garden pupils, but, on the contrary, practical gardeners. Applications for scholarships, and any inquiries regarding them, are to be addressed to William Trelease, director of the Missouri Botanical Garden, St. Louis, Mo.

— The Mexican Government, according to the *Engineering and Mining Journal*, has issued a decree fixing June 30, 1890, as the date for the definite withdrawal from circulation of worn coin and of the coins known as reales, medios, cuartillas, and tlacos. Holders of such coins may before such date exchange them at their nominal value for decimal currency at the National Bank in the City of Mexico, or at its agencies throughout the republic. The mints will recoin the old money into decimal pieces. After the date fixed for the exchange of the old coinage at its nominal value, it may still be exchanged at the mints; which, however, will only redeem it according to its weight and fineness, and not according to the value stamped on it. From and after July 1, 1890, all commercial transactions must be effected on a decimal basis, infractions of this rule being punished by a fine of twenty-five dollars for the first offence and fifty dollars for every subsequent offence. Notaries, in drawing up contracts, are forbidden to mention the coins of the old system, even for the sake of greater clearness, on penalty of a fine of from fifty dollars to one hundred dollars. Any one who, after June 30, shall attempt to pass a coin of the ancient system will incur the same penalties as those awarded for passing illegal coinage.

— The Mexican Government, says the *Economiste Français*, has recently undertaken an inquiry into the internal condition of the country. The following are some of the results obtained by the inquiry: The population of Mexico has increased during the period comprised between the years 1880 and 1888 by 1,487,701 persons; that is to say, 185,962 annually, or an average increase of 2 per cent. The revenue, which amounted in 1880 to $21,936,165, reached the figure of $32,126,508 in 1888, — an increase of $10,190,343. Landed property in Mexico was valued in 1880 at $366,055,052, and at $473,519,871 in 1888. At the end of 1880 there were 15 railway lines in working, with a length of 655 miles. At the end of the year 1888 the lines numbered 47, with a total length of 5,063 miles. In 1880 there were 10,501 miles of telegraph line. In 1888, the telegraph system, including the coast cables, comprised 27,704 miles. The number of telegrams despatched by the Federal Government lines, which amounted in 1880 to 381,607, exceeded 671,000 in 1888. Postal business showed a great increase: the number of letters and newspapers carried in 1880 amounted to 5,788,182, and in 1888 to 27,390,288. From the establishment of the mint, up to the year 1888, the amount of gold coined represented a value of $112,671,000; of silver, $2,194,111,828; and of copper, $5,940,338; making a total of $3,312,723,266. During the economic year 1886–87, the value of the imports into the Republic was $52,252,275; and of the exports, $49,191,930. As regards public instruction, the progress is very marked: the number of schools, which in 1880 was only 8,535, rose in 1888 to 10,726, while the number of scholars increased during the same period from 435,935 to 543,977. Finally, lighthouses have been established in the ports of Vera Cruz, Coazacoalcos, Alvarado, Frontera, Celestun, Sisal, Tampico, Campêche, and Progreso in the Gulf of Mexico, and at Guaymas and Mazatlan on the Pacific.

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CONTENTS:

THE FISKE RANGE-FINDER.

IT has long been recognized as a prime necessity of effective gunnery at sea that the gunners shall know at each instant the exact distance of the ship or object at which they are to shoot. To realize this, we must reflect, that, if two ships are approaching each other at the rate of even twelve knots each, their distance apart is changing at the rate of 13⅓ yards per second. This means that in less than 4 seconds the distance or range will change 50 yards, which represents the distance apart of two consecutive graduations of the sight-bar of a modern rifle-gun: in other words, the sight-bars of high-powered guns are usually graduated to 50 yards, and it is necessary for effective shooting that an error of 50 yards must not be made in estimating the distance and timing the discharge of the gun as the ship rolls from side to side. But if this change of 50 yards be made in 4 seconds, it is plain that we must have an instrument that will give the range with less than 4 seconds' delay, and give it, at the very least, with less than 50 yards error. Such an instrument is called a "range-finder." A description of a new and exceedingly clever, as well as thoroughly scientific device, for ascertaining the range and position of distant objects, designed by Lieut. Bradley Allan Fiske, forms the subject of this article.

The invention consists of a new method of finding the range and position of a distant object, which depends upon the determination of a fractional portion of a conducting body bearing in length a ratio to the angle included between two lines of sight directed upon said distant object and the measurement of the electrical resistance of said length.

The accompanying drawings are (Fig. 4 excepted) all electrical diagrams, not drawn to scale, and symbolically represent the invention. In Fig. 1 is shown a Wheatstone bridge, in one member (a) of which is arranged a body of conducting material in arc form, and a movable arm traversing the same. In Fig. 2 is shown a Wheatstone bridge having arcs and movable arms arranged in two members, a b. In Fig. 3 is shown a Wheatstone bridge in which arcs connect adjacent members, as a c and b d, and movable arms sweeping over said arcs are connected to the battery. Fig. 4 is a mathematical diagram illustrating the method of determining the angle ATC. Fig. 5 shows a disposition of the range-finder in connection with a dead-beat galvanometer; and Fig. 6, the same in connection with the slider. Similar letters of reference indicate like parts.

In Fig. 1, let a b c d represent the four members of an ordinary Wheatstone bridge, and g the transverse member, in which is connected the galvanometer g'. A battery f is also connected to the bridge in the usual way. In the members c and d are placed the fixed resistances c' and d', and in the member b the variable resistance b' also, as usual. One wire from battery f, however, connects to the end of member c, and also to the pivot l of a swinging arm i. The extremity k of arm i moves over and maintains electrical contact with an arc h of conducting material, which has one extremity j connected, as shown, to the member a of the bridge. It is obvious that when the arm i is in the position shown in full lines in Fig. 1, then the current will traverse the whole arc h; and when said arm is in the position indicated by dotted lines (Fig. 1), then the arc h will be cut out, and the current will pass directly to member a. Now assume the arc h to be made of such material, and so proportioned that its electrical resistance to a current traversing it will be proportional to the length of arc included between the contact end k of arm i and the connecting-point j of member a with said arc. Therefore the resistance interposed in the member a of the bridge will be commensurate with the angle j l k; and if this resistance be known, the angle is also known. Let it now be assumed that the galvanometer g' and variable resistance b' be located at some point distant from the moving arm i, from which said arm is invisible or inaccessible. Clearly, then, an observer stationed at the galvanometer g' and resistance b' can, by noting the galvanometer and adjusting the resistance in the usual way, determine the resistance equilibrating any position of arm i along the arc h, and so discover the angle of adjustment of said arc; or, having adjusted the resistance b' at some given figure, the observer may, by simply noting the galvanometer or any other suitable indicating device, visual or audible, determine when the arm i is placed at a desired angle corresponding to the adjusted resistance, and this indicating device may obviously be at the place where the moving arm is located, so that the operator there may thus know when he has placed the arm at the predetermined point or at the distant station, so that the operator in charge of the resistance b' may know that the arm has been adjusted properly; or two indicating devices in the same circuit may give warning to both operators, as above, simultaneously.

Referring now to Fig. 2, it will be apparent, that, in lieu of the variable resistance b' in the member b, there is arranged an arc h' and swinging arm i'. The arc h' is connected at one end j' to the member b, and the swinging arm i' makes contact at one end k' with said arc, and to its pivot l' is connected the member d. The arrangement and construction of arc h' and arm i' are similar to those of arc h and arm i: consequently, when the arm i is set at a certain point on the arc h, the arm i' must be set at the corresponding point on the arc h', in order that the resistance of the lengths of the arcs h h' respectively between the point k and point h and point k' and point h' may balance; hence, if the arm k be set at a certain angle, the observer at arm k may recognize that angle by noting the position of the arm k and the galvanometer, as before. It will be observed, however, that the effect of moving the arm i over arc h is practically to lengthen or shorten or to interpose more or less resistance in the member a of the bridge, and by

operating the arm i' a like effect is produced in the member b. The resistances or lengths of the members c and d remain unchanged.

Referring now to Fig. 3, there is shown an arrangement which forms the basis of the specific embodiment of the invention, more particularly hereinafter described. In said Fig. 3 the arc h is connected at its respective ends j J to the members a c, and the arc h' is similarly connected at j' J' to the members b d. The battery-wires connect to the pivots l l' of the arms i i', as before. Now, when the arm i is moved from its middle position on its arc toward j, less resistance is caused in the member a, and more resistance in member c; and when moved in the opposite direction, the reverse occurs. So, also, a similar effect is produced by moving arm i'; and thus the resistance offered by all four members of the bridge may be affected instead of that due to only two of them, and differential results may be obtained, as will more fully be apparent in the following description of a device for measuring distances, such as a range-finder for guns.

Referring to Fig. 4, let T be the position of the object the distance of which from the point A it is desired to ascertain. Let AB be any short base-line. Draw AC at right angles to BT, EA parallel to BT, and prolong AT as to D. By trigonometry

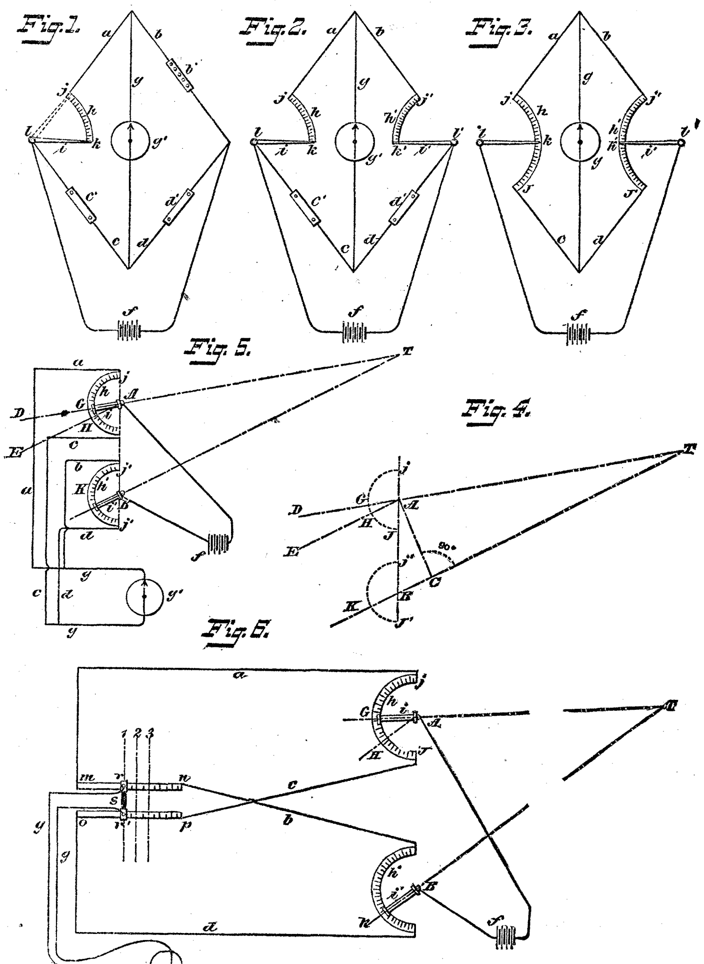
$$\left.\begin{array}{l}\mathrm{AC}=\mathrm{AT}\sin\mathrm{ATC}\\ \mathrm{AT}=\mathrm{AC}\operatorname{cosec}\mathrm{ATC}\end{array}\right\}\text{ and }\left\{\begin{array}{l}\mathrm{AC}=\mathrm{AB}\sin\mathrm{ABC},\text{ whence}\\ \mathrm{AT}=\mathrm{AB}\sin\mathrm{ABC}\operatorname{cosec}\mathrm{ATC}.\end{array}\right.$$

AB, being the measured base-line, is known, and the angle ABC at the point of observation is easily determined, so that the angle ATC remains to be found; but ATC=DAE, and DAE is subtended and measured by the arc GH. Arc GH=arc jH—arc jG, and arc jH=arc J'K: hence arc GH=arc j'K—arc jG.

In Fig. 5 the diagrams Figs. 3 and 4 are combined; i i', as before, being swinging arms traversing the arcs h h', and the connections a b c d of the bridge being present also, as before. Let the arms i and i' represent alidade-arms or telescopes, both directed upon the object T. The arcs jG and j'K not being equal, the bridge will not balance; but when the telescope i is moved to the line EH, then the bridge will balance; but the distance thus moved is the arc GH, the length of which may be read off from the arc h itself. It will be seen, therefore, that the operation of determining the distance AT becomes, by the aid of this apparatus, exceedingly simple. The observers at the respective telescopes i and i' direct their lines of sight upon the object. The observer at i notes the angle jAG, or length of arc jG. He then moves the telescope i until the galvanometer g', which may be placed conveniently near his position, shows no deflection, and notes the angle jAH, or length of arc jH. The difference between the arcs iG and jH equals the arc GH, whence the angle ATB, and hence the distance AT, is found by the observer at the arm i, or, in other words, by an observer at the base-line. The disposition of the apparatus whereby an observer at a point distant from said base-line may at once read off the distance AT from a suitable scale will now be explained.

Referring to Fig. 6, the members a and b of the bridge are connected to opposite extremities of a bar m n of conducting material and the members c d are connected to the extremities of a similar and parallel bar o p. Adjustable upon said bars o p and m n is a slider r r', having a middle portion s of insulating material, so that the current from bar m n, for example, does not pass across said slider r r' to bar o p, but proceeds by the wire g through the galvanometer g''. Suppose, now, that the telescopes i and i' are sighted upon the distant object T, as before, and that the slider r is at the middle point 1 of the parallel bars m n and o p: the resistances in the bridge will obviously not balance. It has already been explained in connection with Fig. 5, how, by moving telescope i to the point H, the resistances might be balanced; and if that were done, with the arrangement shown in Fig. 6, the fact would obviously be indicated by a deflection of the galvanometer-needle; but now let it be assumed that the telescope i, after being sighted upon the object T, is not moved, or, in other words, that the observers respectively at the two telescopes i and i' simply adjust their instruments in line with T. Obviously, then, the distance of the bridge from r to G (member a) is less than the distance from r to k (member b) by the length of the arc GH. Similarly the distance on the bridge from r' to G (member c) is greater than the distance from r' to k (member d) by the length of arc GH.

Now let the resistance per unit length of the bars m n o p be made equal to or with some definite relation to the resistance per unit length of the arcs h h', and lay off on bar m n a distance r 3 and on bar o p a distance r' 3, said distances being such that the resistance due thereto will be equal to that of the arc GH. Clearly, if the end r of the slider be moved to the position 2 on bar m n, the member a will be increased and the member b will be diminished by the distance r 2, which offers a resistance equal to one-half that of arc GH; and if the end r' of the slider be moved to the position 2 on bar o p, then the member c will be decreased and the member d increased by the distance r' 2, which also has a resistance equal to one-half of arc GH. As both ends of the slider move simultaneously, it follows that when its extremities are



adjusted in the position 2, then the bridge will balance and the galvanometer-needle will again be at zero. Applying this practically, let the bars m n o p be laid off in suitable scale-divisions from r to n and i' to p. The two telescopes i and i' being sighted on the object, the distant observer watches the needle, and moves the slider r r' along the bars m n o p until it returns to zero. The scale marked on the bars then shows an indication corresponding to the length of arc GH, or, if desired, actual distances corresponding to such indications.

If the object be moving, the operation of determining its distance is as easy as though it were stationary, and the indications are instantaneous and continuous. With a 290-foot base-line on board the "Chicago," one instrument being mounted in the bow and one in the stern, the average error in the official trial before a board of electrical and gunnery experts was less than six-tenths of one per cent. The set of instruments about being sent to the "Baltimore" is expected to give still more accurate results.

BOOK-REVIEWS.

The Chemistry of Photography. By RAPHAEL MELDOLA, F.R.S. New York, Macmillan & Co. 12°. $2.

THIS book consists of nine lectures which were delivered as a special course at the Finsbury Technical College. With the chemistry of photographic materials, their preparation, properties, and re-actions, and with the practical details of photographic manipulation, the author does not deal, but confines his attention to the consideration of the chemical changes which occur in photographic processes, or the chemistry of photography, properly so called. His object is to present the principles involved in these processes, to show what point has been reached in the explanation of them, and to stimulate further investigation. He hopes, too, "that the present work may contribute toward convincing" purely scientific chemists "that there are many important problems still awaiting solution in this field of research." Each lecture is followed by an appendix containing directions for performing well-selected experiments in illustration of the text. As the lectures were originally addressed to an audience of chemical students and photographers, some elementary knowledge of chemistry is assumed.

The amateur picture-maker who is content "to push the button" and let some professional photographer "do the rest," or who has no ambition beyond the knowledge of the simple manipulative details which enable him to mix his solutions successfully and make passable photographs, will find little to interest him in this book. But all who have felt the real fascination of the "dark room," and desire to know more of the nature of the mysterious action of light and the "developer" on the responsive film, will give it a hearty welcome. The reader must not, however, look to have all his questions satisfactorily answered, or all his difficulties solved; for the subtile re-actions caused by light in the salts of silver are among the most perplexing problems known to chemistry, and photochemical theories are to a large extent still in the speculative stage. Mr. Meldola does not attempt to conceal this fact. He distinctly and repeatedly points out the insufficiency of certain hypotheses in regard to the nature of photochemical processes, and, as it happens, gives in his own constructive efforts one or two striking illustrations of the difficulties which beset the theorist in this obscure region, and tend to lift his feet from the solid ground of experimental facts. It should be said, however, that his theoretical suggestions are free from any undue assertiveness, and are advanced chiefly from the motive that they "may serve as a stimulus to further experimental inquiry" (p. 214). They will perhaps attain this object quite as much through their evident inadequacy and the criticism they will undoubtedly provoke as in any other and more direct way.

Lecture II. is devoted to the discussion of the composition of the darkened product formed from silver chloride under the influence of light. This is a subject of fundamental importance, for the identity of the material of the latent image with this darkened substance is universally admitted. Mr. Meldola rejects the generally accepted subchloride theory, and attempts to show that the product in question is probably an oxy-chloride. The argument against the subchloride is that its existence "is only inferred from the analogy with the metals of the copper group, and is not the result of the analysis of the pure compound" (p. 40). This is hardly a fair statement of the case. It is true that the argument from analogy is flimsy: it does not deserve the attention the author bestows upon it. It is true that no satisfactory direct proof of the existence of the subchloride has been obtained through its isolation and complete analysis; but it is also true that the loss of chlorine which occurs when silver chloride is exposed to light, and the fact that metallic silver is not the result of the action, as well as the whole mass of observation on the effect of light on this and other salts, indicate very strongly that the darkened substance is a *reduction product;* and Cary Lea's brilliant work, two or three years since, on the photo-salts of silver, furnishes weighty evidence that this product is a subchloride united with a larger amount of unchanged normal salt after the manner of a "lake." The most that can reasonably be said against the subchloride theory is that it is not yet absolutely proven by the isolation and analysis of the substance. This is no sufficient ground for its rejection, unless a better theory can be formulated. Mr. Meldola thinks that such is found in the hypothesis that the change produced by light is probably due to the formation of an oxy-chloride of the formula $Ag_4\,O\,Cl_2$. This he supports on an experiment of Robert Hunt's in which oxygen was found to disappear during the darkening of silver chloride, some conclusions of Dr. W. R. Hodgkinson the experimental evidence for which does not seem to have been yet published, and an appeal to the analogy supplied by the darkening of thallous and cuprous chlorides on exposure to light; the change in the case of the latter "being in all probability due to the formation of an oxy-chloride" (p. 57).

Now, not only is direct proof of the existence of the alleged oxy-chloride wanting, but its formation during the action of light is opposed to all the evidence which points to the reducing nature of that action; for the oxy-chloride is in no sense a reduction product, oxygen simply taking the place of chlorine in a complex molecule.

The hypothesis is further in direct contradiction to certain well-known facts which the author has apparently overlooked in his study of the matter, though he gives them place in the discussion of other points. Thus on p. 75 it is stated that hydrogen acts as a sensitizer, accelerating the photo-decomposition of silver chloride; on p. 227, that action goes on under a film of benzene even to the point of reversal; and again on p. 197, that the invisible image is destroyed by oxidizing agents. An action which takes place in hydrogen, or under a liquid destitute of oxygen, and which is undone by oxidizing agents, can hardly consist in formation of an oxy-chloride. It is, in fact, a weak and untenable hypothesis. Not only does it offer the same difficulty which Mr. Meldola urges as a chief argument against the subchloride theory, but it breaks down completely when confronted with facts which the latter readily explains. It is interesting to note that since the appearance of the book, Mr. Lea has published in the *American Journal of Science* a clever bit of experimental work which disposes of the oxy-chloride hypothesis in the most final manner. Mr. Lea found that silver chloride, poured in the molten condition into naphtha, blackened instantly in sunlight, and that a black iodine product was formed by the action of light on metallic silver covered with naphtha containing iodine in solution; that is, the darkened substance is produced under conditions which rigorously exclude all possibility of the presence of moisture or of oxygen in any shape.

In his discussion of the action involved in the reversal of the image on the photographic plate under prolonged exposure to light, or "solarization," as it is often called, the author again shows his lack of that comprehensive grasp of facts and principles which is an essential qualification for all sound theorizing.

The explanation which he proposes for this most perplexing phenomenon is, that in a gelatino-bromide plate, for instance, the bromine lost at first by the silver salt under the influence of light is taken up by the gelatine in which the salt is embedded, until "the vehicle becomes brominated up to a certain degree of saturation; complex bromo-derivatives, or additive compounds, or oxidized products, are formed, and these at length begin to re-act with the reduction product aided by the external oxygen" (p. 225). His conception of the mechanism of the process is clearly given in the closing sentences of Lecture VI.: "A ray of light falling upon a sensitive plate is like the motive power driving a dynamo-machine which is feeding a storage-cell. When the charge of the latter has reached a certain point, it is capable of reversing the motion of the system, and of converting the dynamo into a motor. The sensitizer plays the part of such a storage-cell. When it becomes charged, i.e., halogenized, to a certain amount, the chemical energy stored up in it begins to run down, and reversal takes place." Or, to take an equally pertinent but simpler illustration, the ray of light is like a weight resting on a piston which works in a cylinder full of air. The piston sinks under the weight; but when the compression of the air has reached a certain point, it is capable of reversing the motion of the piston and raising the weight! It does not require a scientific training to see that this is absurd. It is a scheme for perpetual motion. We have every reason for believing that the law of the conservation of energy applies to chemical as well as to mechanical action, and it is obvious that under this law Mr. Meldola's explanation is preposterous.

Aside from these unfortunate ventures, speculative regions, and a certain tendency to looseness of statement, which is, however, in most cases annoying rather than misleading, we find much to commend in the book. It presents the most complete and connected discussion of photochemical theories with which we are acquainted, is in the main accurate in its statements of experimental facts and the explanations which have been proposed for them, and thus forms an important and valuable contribution to the literature of the subject. It is rich in suggestion to the chemist, and will undoubtedly fulfil the author's hope of attracting new workers to this field for experimental inquiry.

Evolution. Popular Lectures and Discussions before the Brooklyn Ethical Association. Boston, James H. West. 12°. $2.

THIS book consists of fifteen different papers, originally prepared for a popular audience, but designed to present the evolution theory in a thorough and scientific manner. They are by many different authors, and deal with all the leading aspects of the subject. The two opening papers treat of the life and work of the two chief expounders of the new doctrine, Darwin and Spencer; then follow others on the evolution of the earth and the solar system; then the biological department is dealt with; while a considerable portion of the book is devoted to the evolution of morals, religion, and society. The essays, or lectures, are in the main well adapted to the special object in view, that of making evolutionary doctrines better known to popular audiences and general readers; for the writers seem to have taken pains to make their subject plain, and to have had good success in doing so. Each lecture, as originally delivered, was followed by a discussion, in which views opposed to those of the lecturer, and even to the evolution theory generally, were sometimes expressed, and which seem to have been of considerable interest; but the report of them in this volume is rather too brief to give an adequate idea of them.

The views expressed in the various lectures are, of course, in the main those of Darwin and Spencer; but we notice, nevertheless, a decided disagreement with those thinkers on certain points. Thus Professor Raymond regards the theory of natural selection as inadequate to account for the derivation of species, and intimates that "Darwin's formula left out more important factors than any of those it contained;" and Professor Cope expressed a similar opinion. Again, Mr. Chadwick, speaking of Spencer's proposed reconciliation of science and religion, says that he "cannot conceive a more senseless and ridiculous reconciliation than this;" and he elsewhere speaks of it as "the disreputable compromise between science and religion." We notice, as the most prominent fact in the series of discussions, that when the subject of religion was introduced, a great divergence of opinion was immediately manifest; one, at least, of the speakers expressing the extremest materialistic views, while the views of others were strongly spiritualistic, and of others still pantheistic. Indeed, it looks very much as if the evolution school was likely to divide, as the Hegelian school did after its founder's death, into three distinct branches, — one theistic, another pantheistic, and the third atheistic. However, we have no desire to set up as prophets; and so we close by recommending this collection of essays to those who wish for a simple but accurate exposition of the evolutionary philosophy.

An Appeal to Pharaoh. The Negro Problem and its Radical Solution. New York, Fords, Howard, & Hulbert. 16°. $1.

THE anonymous author of this work is very much troubled about the negro problem, and he here devotes two hundred pages to a proposed solution of it. He dwells at great length on the fact that the black and the white races in this country show no sign of intermingling even socially, and paints in extraordinary colors the antipathy that exists between them. He maintains that in the Southern States the two races are farther apart in feeling, and less disposed to social intercourse with each other, than they were when slavery prevailed; and he fears that this estrangement will increase with the progress of time. In the North, too, he asserts that the separation of the two races is scarcely less marked; and for this race antipathy there is, in his opinion, no cure. Moreover, he predicts that all sorts of evils will result from this antipathy in the future; that race conflicts of one kind or another will continually arise; and that there will never be harmony between the North and South till the negro is got rid of. And so he proposes to send the whole body of seven million blacks back to Africa, whether they will or no. A colony is to be planted on the Kongo or somewhere else, and the negroes are to be transported thither, the United States paying for their passage, and also furnishing them a little money with which to begin their new life. The author fears that his scheme will be pronounced impracticable, and devotes a great deal of space to showing how it could be put into execution. To our mind, however, the scheme is not so much impracticable as inhuman; though its inhumanity is perhaps exceeded by its silliness. If the negroes should choose to emigrate, there is no objection to their doing so; but this proposal to compel them to go is one to which the American people will not listen. The negro is here to stay, and men like the author of this book must make up their minds to treat him with justice and fairness; and when they do so, all danger of trouble between the two races will disappear.

The Psychology of Attention. By TH. RIBOT. Chicago, Open Court Publ. Co. 12°. 75 cents.

THIS work is an authorized translation from the French, and originally appeared in the pages of the *Open Court*. It might better have been entitled the "physiology" of attention, for it treats almost entirely of the motions and other physical phenomena that accompany attention, and has very little to say about attention itself. The author defines attention as "an intellectual state, exclusive or predominant, with spontaneous or artificial adaptation of the individual;" yet when he comes to treat the subject he neglects the intellectual state entirely, and confines himself to its physical and emotional accompaniments. The thesis that he attempts to prove is that every species of attention is invariably accompanied by certain motor changes in the bodily frame, and that these are so essential to attention that they may almost be said to constitute it. In other words, after defining attention as an intellectual state, M. Ribot treats it as if it was a bodily state. Moreover, he fails to show that attention is always accompanied by motions or motor phenomena. Of course, in the case of sense-perception the motor element in attention is apparent; but in the case of abstract thought it is not at all apparent to the ordinary consciousness, and M. Ribot does not make it any more so. Nevertheless there is much in his book that will be interesting, especially to students of psycho-physics. The work is divided into three parts, treating successively of spontaneous, voluntary, and morbid attention; and under all these heads are presented facts and ideas that will serve towards a more perfect theory of attention hereafter.

AMONG THE PUBLISHERS.

THE supplement to *Harper's Weekly* of Jan. 18 contains an interesting article on recent discoveries in the Kongo basin, detailing "the geographical surprises and new-found peoples of the past five years." The article is from the pen of C. C. Adams, and is illustrated by a large map and several other engravings.

— The picturesque forest pavilion at the Paris Exposition is illustrated and described in *Garden and Forest* for Jan. 15, where we find, as well, an account of the delightful voyage down the Rhone, so seldom made by tourists, and a picture of a positively unique orchid, *Phalænopsis F. L. Ames.*

— The closing volume of C. A. Fyffe's "History of Modern Europe" is now in the hands of Cassell & Co. The volume embraces the period from 1848 to 1878, and throws, we understand, considerable light on the complex problems in European politics which led to the Franco-Prussian war.

— More than twelve thousand letters and manuscripts of John Ericsson, the great engineer, have been put in the hands of Col. W. C. Church, to use in the preparation of his biography. The first of two articles on Ericsson, by Col. Church, will appear in the February *Scribner's*, with some illustrations from rare sources, among them the reproduction of an engraving made by Ericsson at the age of eighteen. G. Frederick Wright, president of Oberlin College, will have a short article on the curious and very ancient image thrown up not long ago by an artesian well at Nampa, Idaho.

—Robert Clarke & Co. announce the following important publications: "Fort Ancient," an account of the great prehistoric earthwork of Warren County, O., by Warren K. Moorhead of the Smithsonian Institution; "A History of the Girtys," the curious record of certain "renegades" of the American revolution, by Willshire Butterfield; and "Monographs of the Kentucky Geological Survey," by John R. Prooter, director.

—William Hodge & Co., Glasgow, will shortly publish by subscription a book entitled "Trial by Combat," by George Neilson. The author traces the history of the judicial duel in both England and Scotland, and he claims that, by this comparative treatment, he is enabled to throw light on many hitherto unexplained features in the law and practice of both countries. In particular, he deals with the duel on the borders under the march laws, and with the famous combat of the clans on the Inch of Perth, in 1396.

—Francis Galton, F.R.S., contributes an article entitled "Why do we measure Mankind?" to the February number of *Lippincott's Magazine*. Mr. Galton shows the importance of being measured, weighed, and otherwise tested, according to the modern method, by a competent examiner, and especially the importance of applying this system of measurements to young people, in order to determine their capacity and fitness for special pursuits. Another timely article, "The Salon Idea in New York," is contributed by C. H. Crandall. The author thoroughly believes in the *salon* idea, and holds that the *salon* ought to, and perhaps will, become a great power in our social and political life. The former power and influence of the French *salons* are touched upon, and pictures are given of many charming literary drawing-rooms in New York City.

—Messrs. Ginn & Co. announce for publication "Plant Organization," by R. Halsted Ward, M.D., professor of botany in the Rensselaer Polytechnic Institute, Troy, N.Y. This book is a guide to the study of plants. It consists of a synoptical review of the general structure and morphology of plants, clearly drawn out according to biological principles, fully illustrated, and accompanied by a set of blanks for writing-exercises by pupils. It also provides for some easy microscopical work, if desired. Though requiring a very thorough study and exact understanding of the plants which may be selected for study, the work is so systematized and simplified as to be adapted to the use of beginners, in connection with personal instruction or with any text-book of botany however elementary, and either with or without the employment of technical botanical terms. The work, which is designed for private students or for classes in academies, seminaries, high schools, etc., is now issued in a second and revised edition, after having proved its value.

—From Providence, R.I., comes a new monthly, the *Board of Trade Journal*, which will publish from month to month the record of the meetings of the Board of Trade, its reports, business statistics of various kinds, and other matter pertaining to the business interests of Providence and vicinity. The numbers that have already appeared are well gotten up, and full of interesting matter.

—Messrs. Cassell & Co. announce that they have secured the publication of the memorial volume to the late Henry W. Grady. The book, which will be ready for publication within a few weeks, has been compiled by his co-workers on the Atlanta "Constitution," and edited by Joel Chandler Harris. It will contain a complete life of Mr. Grady, and such of his writings and speeches as best represent his gifts as writer and orator.

—With the growth of interest in this country in all out-door sports it is natural to expect an improvement in the supply of articles intended to make the enjoyment of such relaxation the greater. One evidence of this development of a new phase of American life is shown in a catalogue of sportsmen's supplies we have received this week from Henry C. Squires, 178 Broadway, New York. This catalogue is intended for those who, having given little or no thought to out-door sports, desire information. It is supposed that such persons desire to know not merely the prices of articles, but, to some extent, what they want and why they want it. The catalogue aims to give such information as will aid those seeking firearms, fishing-tackle, or camping goods in securing what is best suited to their needs. Not only does this catalogue give the prices and describe the goods, but Mr. Squires has introduced a large number of the very best illustrations, picturing scenes incident to out-door sports, and tending to render this catalogue unique in its typographical attractiveness. But this is not all, for these pictures — for they are real pictures, and not the crude cuts so often disfiguring printed pages — are likely to arouse an interest for the life they depict in those who have known little of it, and to rekindle the desires of those who may have put sports aside.

— A. L. Burt has issued a volume on "Fugitive Facts," edited by Robert Thorne. It comprises short articles, alphabetically arranged, on topics constantly arising in conversation and general reading, on which it is hard to find accurate and definite information. The queries in the correspondence departments of periodicals and newspapers have suggested many of the subjects treated. The editor has added an appendix, devoted to short selections of constantly used medical terms and short dictionaries of mythology and music.

— G. P. Putnam's Sons will publish shortly a new volume, in The Story of the Nations Series, entitled "The Story of the Barbary Corsairs," by Stanley Lane Poole, with the collaboration of Lieut. J. D. Jerrold Kelley of the United States Navy; and two new books in The Questions of the Day, on "Railway Secrecy," by John M. Bonham, and "American Farms," by J. R. Elliot.

— The December number of the Riverside Literature Series (published quarterly during the school year 1889-90 at 15 cents a number, by Houghton, Mifflin, & Co., Boston) contains "Waste Not, Want Not, and The Barring Out," from Maria Edgeworth's "Parent's Assistant." The great popularity which the "Parent's Assistant" has had, ever since its publication in 1822, has induced the publishers to include some of the stories from this book in the Riverside Literature Series. The stories selected are interesting and simple: the lessons which they inculcate are the advantage of frugality and the disadvantage of a blind party spirit. The same publishers announce that they have in press for early publication a book by John Fiske on civil government. This book treats in a simple way of the government of towns, cities, states, and the nation, and will be a most valuable book for schools and families.

— Andrew D. White will resume his "New Chapters in the Warfare of Science" in the February *Popular Science Monthly*. The forthcoming chapter will be on "Comparative Mythology." It deals with the myths invented to explain strangely shaped or distributed rocks, taking the story of Lot's wife, which has gone through many curious variations, as a special example. "The Localization of Industries" is the subject of an article by J. J. Menzies, to appear in the February number, which will throw light on the most important problem before Congress this winter. It tells what lessons science draws from the course of industrial evolution in regard to encouraging the establishment of industries in a country. A searching examination of Henry George's taxation doctrine, by Horace White, will appear under the title, "Agriculture and the Single Tax." Mr. White maintains that the interdependence of all industries disposes of the claim that agriculture has enough advantage over other occupations to warrant laying the burden of all taxation upon it, and he asks whether the scheme of "economic rent" would include paying a bounty to farmers whose profits are a minus quantity. A second instalment of "Letters on the Land Question," from Huxley, Spencer, and others, including an especially able review of the question by Auberon Herbert, will be printed.

— Fords, Howard, & Hulbert have published a small volume by Martin W. Cooke on "The Human Mystery in Hamlet," the object of which is to present a new view of the character of Hamlet himself. The theories of Hamlet's character that critics have heretofore advanced are many and various, but Mr. Cooke's theory is quite different from them all. He holds that the dramatist's object in exhibiting the career of Hamlet was to portray "the conflict between his will and his passions, . . . the strife between the higher forces of the being and the lower." Or, as he elsewhere expresses it, "the theme of Hamlet is the interior life of humanity in this world, striving to harmonize its actions with a supernaturally imposed law of rectitude, which it recognizes but ever fails to fulfil." Now, we confess that this theory is less satisfactory to us than any of its predecessors, for we cannot see the least indication of a *moral* conflict in Hamlet's action or conversation — indeed, we should say that the moral element was conspicuously absent; nor can we see the propriety of calling the command of a ghost "a supernaturally imposed law of rectitude." Students of Shakspeare will take an interest in reading Mr. Cooke's work, but we doubt if they will agree with its conclusions.

LETTERS TO THE EDITOR.

****Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

Physical Fields.

PROFESSOR DOLBEAR'S interesting article on "Physical Fields," that appeared in your issue of Dec. 27, was called to my notice, and I have read it with considerable attention. It seems to me that he is entirely wrong in some of his premises, and that his conclusions are therefore, some of them, untenable. With your permission, I will point out where I differ with him.

His use of the term "stress" is certainly not correct. He says, under the head of "The Electric Field," "The phenomena are explained as due to the stress into which the neighboring ether is thrown by the electrified body. . . . Experiment shows that this kind of a stress travels outwards with the velocity of 186,000 miles a second, or the same as that of light."

It does not seem to me to be proper to say that a stress travels: it rather exists. In this particular case he is referring to the phenomenon of electrification, which is a static effect or condition. As I understand Maxwell, and Hertz and Thompson and Lodge, they do not any of them believe that electrification involves motion in any way whatever. It is a condition which is dual in its character. The negative exists because of the existence of the positive, not because of propagation from one to another. They also believe that one cannot exist without the other: the very existence of one, therefore, involves the existence of the other. The element of time, and therefore of rate of propagation, must be eliminated entirely.

What he does mean is, that an impulse due to the yielding to this stress is propagated, etc.

Again he says, "If this assumed electrified mass of matter were the only matter in the universe, any electric change in the mass would ultimately re-act upon the whole of space, and be uniform in every direction." This statement involves a contradiction of terms, for how can we have a condition of stress that is uniform throughout all space? It is certainly true that under static conditions, or under conditions of stress generally, where there are two bodies or more concerned, the field is distorted by their mutual re-action (that constitutes the stress); but I maintain that where there is but a single body in space, there can be no such thing as stress in that space outside of the body itself. If the body in question be but a mathematical point, there can be no stress at all. There can be no tension on a cord that is perfectly free to move.

The same criticism is made upon his remarks under the head of "The Magnetic Field." In the case of the magnet the justice of my criticism will be, perhaps, more apparent. Were it possible to conceive of a magnetic particle with but a single pole, could we imagine that pole surrounded by a magnetic field? Our conception of the ultimate particle of magnetic matter endows it with two parts, which re-act upon each other. If there were but a single particle of magnetic matter in space, the "lines of force" would form closed curves within that particle, passing from pole to pole: they could not, without violating all the laws of stress, radiate off into space, as he says they would.

Under the third head, "The Thermal Field," we come to a very different class of phenomena. Here, as in the case of light, we have vibration: we have distinctively a condition of motion of the ethereal medium. We have passed from a state of rest, — a static condition, — a state of potential, to one of movement, — a kinetic condition.

He says, "A hot body has a field, as well as an electrified or a magnetized body:" so it has, but his fundamental and fatal error is in not being able to discriminate between the two kinds of field. The magnetic, the electric, and we may add the field of the force of gravity, are purely static, purely potential, whereas the luminous and thermal fields are kinetic. In the former there can be no propagation, as the element of motion is entirely wanting. Add to these fields of stress the element of motion, and they at once become kinetic, and will then obey the laws of kinetic fields.

A potential field without motion will exist forever: a kinetic field requires the continual addition of energy for its maintenance. Move a magnet, or the earth relatively to any other magnet or body, and kinetic fields are produced. Move an electrified body,

or cause its field to change in any possible way, and we have again a kinetic field.

If, however, there be but a single body in space surrounded by a potential field, the movement of that body, while the movement in itself will constitute kinetic energy, still would not convert the potential energy into kinetic.

He says, "So, if there were but a single hot body in the universe, it would impart its energy to the ether and approach infinitely near absolute zero; while an electrified body or a magnet would be perfectly insulated, and, so far as is known, would lose none of its properties, however long it was thus kept. There is no static condition in heat phenomena: exchange is constant. These facts indicate that light or radiant energy is no more an electro-magnetic phenomenon than magnetism is a thermal phenomenon, but that it is one of a distinct order."

The only difference is that in one case there is stress alone, and in the other there is motion, a yielding of that stress. Take away motion from one, or add motion to the other, and the phenomena are identical in kind.

It is the difference between a reservoir full of water on a hill, and that same water in the act of falling from its elevation. It requires an expenditure of energy to fill the reservoir, — to produce the stress or static or potential condition, — but involves no expenditure of energy to maintain that condition. We have in the elevated reservoir of water the analogue of magnetism, electrification, gravity. Let this water fall from its position, and we have something that corresponds to light, — the galvanic current, heat, etc. It requires the expenditure of energy to get these forms of energy, and it requires the expenditure of energy to maintain them.

We must regard electricity as motion; electrification, one kind of stress which is capable of producing electrical vibrations; magnetism may be another. We may compare magnetism, electrification, and gravitation to different tensions of a given string on a violin; and electricity, light, heat, etc., as the tones produced by that string when struck under these varying tensions.

NELSON W. PERRY.

Cincinnati, O., Jan. 15.

The Orthography of "Alleghany."

THIS name appears in several forms, all of which are in common use; and it goes without saying, that in each particular locality there is a disposition to insist on the local orthography of the word. Thus, in the city and the county in western Pennsylvaina, "Allegheny" is the form officially recognized. In the county of New York, "Allegany" is the adopted form. The range of mountains, however, almost always appears under the form "Alleghany." I know of but one exception to this custom; namely, that used by the Engineer Department of the Pennsylvania Railroad: there the range appears as "Allegheny."

In looking up the history of this word, I found nothing authoritative bearing upon the subject in the literature of the State Geological Survey; but a search among the earlier maps of the State throws light on the subject, a number of which were placed at my disposal through the courtesy of Mr. McAlister of Philadelphia.

On Adlum and Walter's map, 1790, the name appears in one form only, "Allegany." On Reading McDowell's map, 1792, it appears as "Allegheny" mountains and "Allegany" River. On Morris's map, drawn by Barnes, 1848, "Allegheny" is the form used for both river and range.

The first and only early map on which I could find the more common form, "Alleghany," is in Mitchell's "Atlas," edition of 1853. These maps were drawn by Mr. Young, and it is more than likely that the same form appeared on previous editions of this atlas. It is only a matter of justice to say here that Mr. Young was the real author of Mitchell's "Geography" and "Atlas."

Thus it seems that the earliest authorized form of the word is "Allegany." When, however, "Allegheny" was adopted, it was evidently the intention to preserve the long sound of *a* by the French *e*; but, in order to avoid softening the preceding guttural consonant, *h* was interpolated, thereby converting "Allegany" into "Allegheny." Subsequently, when the *a* was again restored, the *h* was needlessly left in the word, — needlessly because there would be no probability of a guttural becoming softened before *a*. It is evident, therefore, that while the change to "Allegheny" may be considered of questionable propriety, the now recent form "Alleghany" is an unauthorized monstrosity.

JACQUES W. REDWAY.

Philadelphia, Jan. 18.

Mocking-Birds' Phrases.

WHILE idling at Colonial Beach last spring, the varied phrases of the mocking-bird attracted my attention. One phrase, "pen and ink, pen and ink, pen and ink" was startlingly articulate, and often repeated. So I took my pencil and noted what I heard. Changes of rhythm and changes of vowel brought out with wonderful clearness all the following phrases, apparently from only two birds. The phrases were interspersed with an occasional trill, a whistle, and a mew.

Hurry up! hurry up! hurry up!
Chip chip chip chip chip!
Teetle teetle teetle teetle!
Birdie birdie birdie birdie!
Pen and ink pen and ink pen and ink!
Twitter twitter twitter!
Take care′ take care′ take care′!
Whit whit whit whit!
Tit it it it it it it!
Pee′wit pee′wit pee′wit!
Chivy chivy chivy!
Look away′ look away′ look away′!
Give′ it up give′ it up!
Wit wit wit wit wit wit wit!
Johny Johny Johny!
Hear hear hear hear hear!
Ladle ladle ladle!
Go there′ go there′ go there′!
Not yet not yet not yet!
Wait a wee wait a wee!
Git out git out git out!
Hooray hooray!
Don't go away don't go away!
Chirrup chirrup chirrup!
Say away say away!
That is just′ it that is just′ it!
Look out look out!
Too too too too!
Tut tut tut tut!
Look here′ look here!
That'll do that'll do!
Wheat wheat wheat!
Chickee′ chickee′ chickee′!
Will you sing′ will you sing′ will you sing′?
Teazle teazle teazle!
Chew chew chew!
Took took took took!
Tweet tweet tweet!
Tik tik tik tik!
Cheep cheep cheep!
Pick it up pick it up!
Beauty beauty beauty!

There were many more, for which I could not on the instant find representative words. I have not attempted to record any from memory. The above were noted just as they were heard.

A. MELVILLE BELL.

Washington, D.C., January, 1890.

Musical Flames.

THE well-known experiment of making sounds by holding a tube over a jet of burning gas (usually hydrogen) is often omitted in chemistry classes because no suitable tubing is at hand. A fact not noted in any text-book I have seen, and unknown to all teachers that I have consulted, has been brought to light in my classes; viz., a bottle will serve in place of a tube. A "philosopher's candle" properly burning will yield a fine sound if capped by a wide-mouthed bottle, as a quinine bottle or large test-tube. Of course, this is according to the principles of acoustics, but it seems strange that no text-book gives it. I should like to know if this fact is known to any one else.

T. BERRY SMITH.

Fayette, Mo., Jan. 14.